

TM 5-3895-281-15

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

**OPERATOR, ORGANIZATIONAL
DIRECT SUPPORT, GENERAL SUPPORT
AND
DEPOT MAINTENANCE MANUAL**

**HEATER, HOT OIL, TRAILER MOUNTED:
ELECTRIC MOTOR DRIVEN
2,100,000 BTU/HR OUTPUT
(HOPKINS MODEL 200STM)
FSN 3895-838-9180**

This copy is a reprint which includes current
pages from Changes 1 and 2.

**HEADQUARTERS, DEPARTMENT OF THE ARMY
NOVEMBER 1968**

CHANGE }
No. 1 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., 2 April 1969

**Operator, Organizational, Direct Support,
General Support, and Depot Maintenance Manual**

**HEATER, HOT OIL, TRAILER MOUNTED: ELECTRIC MOTOR
DRIVEN, 2,100,000 BTU/HR OUTPUT
(HOPKINS MODEL 200STM) FSN 3895-838-9180**

TM 5-3895-281-15, 21 November 1968 is changed as follows:

Page 67. Paragraph 75.a.2. and 75.c.1. "Fig. 25" is changed to "Fig. 25A."

Paragraph 76.a. and 76.c. "Refer to Fig 25" is changed to "Refer to Fig. 12 and Fig. 25A."

Paragraph 77.a.2. and 77.c.1. "Refer to Fig. 25" is changed to "Refer to Fig. 12 and Fig. 25A."

Page 78. Paragraph 86.b. the following is added:

1. Remove the two cover screws and cover.
2. Loosen the nut and remove the UV-1 scanner.

Page 81. Paragraph 88.e.4. the following note is added after the last sentence.

Note. If satisfactory results are not obtained then report to direct support and have the CO₂ content at the exhaust stack tested as directed in the following paragraph.

Page 81. Paragraph 88.e.5. The following is added after the last sentence. (This test is not an organizational function).

Page 82. Paragraph 91.a.1. "(Para. 17)" is changed to "(Para. 17 and Para. 18)."

Paragraph 91.a.2. is deleted.

Page 95. Paragraph 103.a., 103.c. and 103.d. "Refer to Fig. 61B" is changed to "Refer to Para 182."

Page 118. Paragraph 133 is deleted.

Page 122. Paragraph 148.a.14. "(Para. 186)" is changed to "(Para. 100)."

Paragraph 148.a.16. "(Para. 188)" is deleted.

Paragraph 148.b.2. "(Para. 190)" is changed to "(Para. 192)."

Paragraph 148.b.14. "(Para 178)" is changed to "(Para. 176)."

Page 142. Paragraph 182.a. "(Fig. 40)" is changed to "(Fig. 61B)."

Page 145. Paragraph 187.b. After the last sentence the following is added. Refer to Fig. 62.

Paragraph 188.a. is deleted.

Paragraph 188.b. This paragraph number is changed from "188.b." to "188."

APPENDIX III

MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

1. General

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. Section II designates overall responsibility for the performance of maintenance functions on the identified end item or component. The implementation of the maintenance functions upon the end item or component will be consistent with the assigned maintenance functions.

c. Section III. (Not Applicable)

d. Section IV. (Not Applicable)

2. Explanation of Columns in Section II

a. *Group Number, Column (1).* The functional group is a numerical group set up on a functional basis. The applicable functional grouping indexes (obtained from TB 750-93-1, Functional Grouping Codes) are listed on the MAC in the appropriate numerical sequence. These indexes are normally set up in accordance with their function and proximity to each other.

b. *Functional Group, Column (2).* This column contains a brief description of the components of each functional group.

c. *Maintenance Functions, Column (3).* This column lists the various maintenance functions (A through K) and indicates the lowest maintenance category authorized to perform these functions. The symbol designations for the various maintenance categories are as follows:

C — Operator or crew

O — Organizational maintenance

F — Direct support maintenance

H — General support maintenance

D — Depot maintenance

The maintenance functions are defined as follows:

A — *Inspect:* To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

B — *Test:* To verify serviceability and to detect electrical or mechanical failure by use of test equipment.

C — *Service:* To clean, to preserve, to charge, to paint, and to add fuel, lubricants, cooling agents, and air.

D — *Adjust:* To rectify to the extent necessary to bring into proper operating range.

E — *Aline:* To adjust specified variable elements of an item to bring to optimum performance.

F — *Calibrate:* To determine the corrections to be made in the readings of instruments or test equipment used in precise measurement. Consists of the comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared with the certified standard.

G — *Install:* To set up for use in an operational environment such as an emplacement, site or vehicle.

H — *Replace:* To replace unserviceable items with serviceable assemblies, subassemblies, or parts.

I — *Repair:* To restore an item to serviceable condition. This includes but is not limited to, inspection, cleaning, preserving, adjusting, replacing, welding, riveting, and strengthening.

J — *Overhaul:* To restore an item to a completely serviceable condition as prescribed by maintenance serviceability standards using the Inspect and Repair Only as Necessary (IROAN) technique.

K — *Rebuild:* To restore an item to a standard as nearly as possible to original or new condition in appearance, performance, and life expectancy. This is accomplished through complete disassembly of the item, inspection of all parts or components, repair or replacement of worn or unserviceable elements (items) using original manufacturing tolerances and specifications, and subsequent reassembly of the item.

d. *Tools and Equipment, Column (4).* This column is provided for referencing by code the special tools and test equipment, (sec. III) required to perform the maintenance functions. (Not Applicable).

e. *Remarks, Column (5).* This column is provided for referencing by code the remarks (sec. IV) pertinent to the maintenance functions. (Not Applicable).

Section II. MAINTENANCE ALLOCATION CHART

(1) Group No.	(2) Functional group	(3) Maintenance functions											(4) Tools and equipment	(5) Remarks
		a	b	c	d	e	f	g	h	i	j	k		
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
06	ELECTRICAL SYSTEM													
0609	Lights:								O	O				
0613	Hull or Chassis Wiring Harness:													
	Wire assembly								F	O				
0617	Trailer Couplings													
	Cable assembly								F	O				
11	REAR AXLE													
1100	Rear Axle Assembly								O	F				
	Axle, rear								O					
12	BRAKES													
1202	Service Brakes									O				
1204	Hydraulic Brakes System													
	Master cylinder power								O	F				
	Cylinder wheel								O	F				
	Lines, fittings, clips								O	O				
	Hose, hydraulic								O					
1208	Air Brake System													
	Lines, air supply								O					
	Hoses, air supply								O					
	Filter air line			C					O					
	Air chamber ay								O	O				
	Relay valve ay			O					O					
	Tank reservoir, air			C					O	F				
13	WHEELS AND TRACKS													
1311	Wheel Ay													
	Bearings								O					
	Hub and drum								O	F				
	Seal, oil								O					
1313	Tires								O					
	Tubes								O	O				
15	FRAME													
1501	Frame Assembly:													
	Platform assembly, front and fender								O	O				
	Ladder; handrail									O				
16	SPRINGS & SHOCKS													
1601	Springs								O	O				
1604	Shocks								O	O				
18	HOOD AND HULL													
1801	Hull Assemblies:													
	Splash guard								O					
1808	Boxes:													
	Stowage: boxes & reel								O	O				
22	ACCESSORY ITEMS													
2202	Accessory Items:													
	Chock blocks; reflectors; service cables; hose								O					
2210	Data Plates:													
	Plate, data								F					
	Plate, instruction								O					
40	ELECTRIC MOTORS													
4000	Major Assemblage; Motor													
	Generator:													
	Motor, pump								O	F				

(1) Group No.	(2) Functional group	(3) Maintenance functions											(4) Tools and equipment	(5) Remarks
		a	b	c	d	e	f	g	h	i	j	k		
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
4001	Rotor Assemblies:													
	Rotor								F	F				
4002	Stator Assemblies:													
	Stator								F	F				
4004	Ventilating System:													
	Fan								F					
4005	Frame Support and Housings:													
	Frame								H					
4010	Master or Auxiliary Control Assembly:													
	Starters, motor								O	F				
	Heater								O					
4018	Junction Boxes:													
	Junction boxes								O					
42	ELECTRICAL EQUIPMENT													
4201	Transformer								F					
4202	Electrical Controls													
	Control box								F	O				
	Wiring								O					
4203	Cutoff Devices, Fuse, Fuse Holders:													
	Cutoff, low fluid level				O				O	F				
	Fuse block; fuse								O					
	Control, pressure, photocell; cable; jack; valve; oil switch								O					
	Program controller								O					
4206	Thermostat, Automatic and Manual													
	Control Devices:													
	End switch								O					
	Controller, temperature		F						F	F				
4209	Signaling Devices:													
	Lamp	O							O					
4216	Miscellaneous Wiring and Fittings:													
	Junction box; conduits; wires; connector; clamps	O							O					
47	GAUGES													
4702	Gauges:													
	Gauge, temperature and pressure	O	F						O					
	Gauge, liquid level	O							O					
	Lines and fittings	O							O					
55	PUMP													
5500	Pump Assembly:													
	Pump circulating				O				O	F				
	Pump base plate								O					
5501	Shaft; Impeller:													
	Shaft, impeller								F					
5502	Rings, Bearings:													
	Bearings; rings								F					
5508	Lubricators:													
	Pump drain lines; cup			C					O					
5511	Couplings:													
	Coupling, drive								O	O				
	Guard								O					

(1) Group No.	(2) Functional group	(3) Maintenance functions											(4) Tools and equipment	(5) Remarks
		a	b	c	d	e	f	g	h	i	j	k		
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
5513	Fluid Lines:													
	Piping assemblies								F	F				
	Valves								F	F				
	Lines; fittings; strainer			C					O					
	Valve 3 way			C					O					
10	HEATING UNITS													
6001	Housing and Installation:													
	Hull, heater			C						F				
	Vent filler piping								O					
6004	Plate, rear; viewer assembly								O					
	Fuel System:													
	Pump, fuel				O				O					
	Strainer, fuel			O					O					
	Lines and fittings								O					
6005	Burner Assembly:													
	Plate, transformer; air cone								F					
	Burner head								F					
	Blower								O	O				
	Transformer, igniter								O					
	Nozzle and electrode				O				O	O				
	Damper control; butterfly; coupling								O					
6006	Motor Assembly:													
	Motor, blower		O						F					
6010	Exhaust System:													
	Stack, exhaust								O	O				
6011	Combustion chamber:													
	Refractory								H					
6013	Heat Exchanger Assembly:													
	Coil, heater								H					
76	FIRE FIGHTING EQUIPMENT													
7638	Fire extinguisher:													
	Extinguisher, fire								O					

By Order of the Secretary of the Army:

Official:

KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

Distribution:

To be distributed in accordance with DA Form 12-25, Section II, (qty rqr block no. 422) Organizational Maintenance requirements for Heaters, Bituminous.

Changes in force: C 1 and C 2

TM 5-3895-281-15
C 2

Change }
No. 2 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 25 September 1973

**Operator, Organizational, Direct Support,
General Support and Depot Maintenance Manual
for
HEATER, HOT OIL, TRAILER MOUNTED:
ELECTRIC MOTOR DRIVEN, 2,100,000 BTU/HR OUTPUT
(HOPKINS MODEL 200STM) FSN 3895-838-9180**

TM 5-3895-281-15, 21 November 1968, is changed as follows:

Page 8. Paragraph 1 is superseded as follows:

1. Scope

a. This manual is for your use in operating and maintaining the Hopkins Hot Oil Heater, Model 200STM.

b. The reporting of errors, omissions, and recommendations for improving this manual by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recom-

mended Changes to Publications) and forward direct to Commander, US Army Troop Support Command, ATTN: AMSTS-MPP, St. Louis, MO 63120.

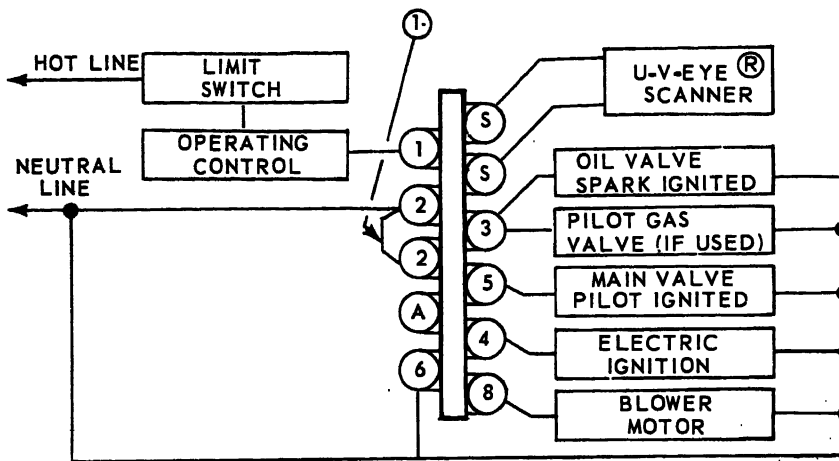
c. Report all equipment improvement recommendations as prescribed by TM 38-750.

Page 13, paragraph 4b (7). In line item 2, change "UVM-2A" to read "UVM2A30".

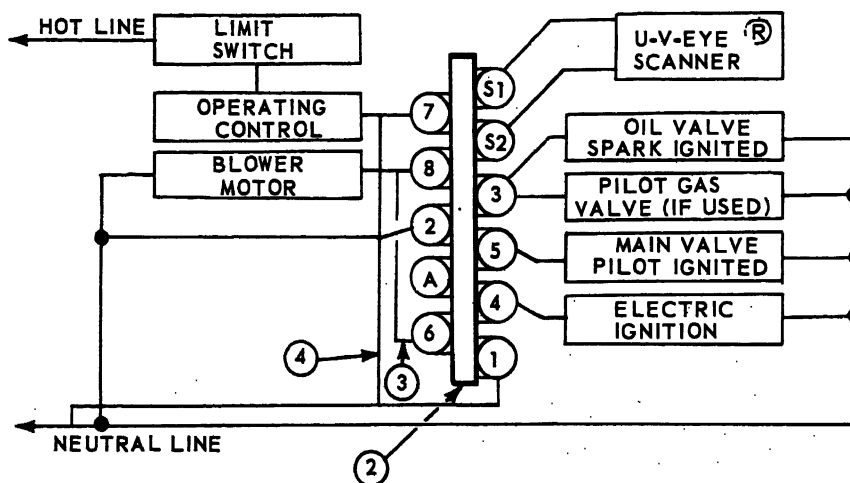
Page 14, paragraph 4b (20). In line item 2, after "V4046B 10491" add "(Low Fire)"; in line item 3, after "V4046A 10741" add "(High Fire)"; in line item 5, after "8314A41" add "(Damper Control)".

Page 19. After figure 5, add figure 5A as follows:

BASE AS ORIGINALLY INSTALLED
FOR TYPE UVM-2A.



TO CONVERT BASE INSTALLED FOR UVM-2A FOR INSTALLATION OF CONTROL TYPE UVM-2A30
REARRANGE WIRING AS SHOWN BELOW



1. REMOVE THE JUMPER BAR BETWEEN THE #2 TERMINALS AND DISCARD.
2. INSTALL NEW TERMINAL IDENTIFICATION MARKER OVER PRESENT MARKINGS.
3. INSTALL JUMPER BETWEEN #6 AND #8 TERMINALS.
4. INSTALL JUMPER BETWEEN #1 AND #7 TERMINALS.
5. ASSURE GROUND WIRE (COLOR CODED GREEN) IS CONNECTED TO #2 TERMINAL.

Figure 5A. Rewiring of UVM2A base when replacing UVM2A
controller with UVM2A30 controller.

ME 3895-281-15/5A C2

Page 24A, paragraph 10. After paragraph 10b,
add paragraph c as follows:

c. Maintenance and Operating Supplies. Main-

tenance and operating supplies required for
initial 8 hours of operation for the heater are
contained in table A.

Table A. Maintenance and Operating Supplies

(1) Component application	(2) Federal stock number	(3) Description	(4) Quantity required t/initial operation	(5) Quantity required t/h operation	(6) Notes
5513-VALVES STRAINER	9150-261-8289	STICK GREASE, GRG-MIL-C6032, 24 sticks per box	1 stick	1 stick	(1) Heat transfer oil is not consumed.
6601-VENT, FILLER PLUG	9150-965-2304	LUBRICATING OIL (TRANSFER OIL), GENERAL PURPOSE, 55 GAL DRUM, MIL-L-22851, TYPE 3	230 gal	See Notes (1), (2), and (3)	(2) The heater normally contains 230 gallons of oil when shipped.
6004-FUEL STRAINER	9140-286-5294	FUEL OIL, BURNER, BULK # 2-FUEL OIL, GAL	See Note (4)	200 gal	(3) Some user systems may require additional oil be added. (4) External Fuel Supply. Maximum fuel consumption is 26 gallons per hour of continuous operation.

Page 25. Add the following to figure 9.

NOTE

When Hi-Fire is on, fuel pressure is directed through the Hi-Fire oil valve to the damper actuator oil valve thence to the damper actuator which opens the damper. When the burner is on Lo-Fire or is off, the Hi-Fire valve closes and the oil pressure in the damper actuator is bled off (through the two-way damper actuator oil valve to the oil return line). The damper returns to the closed position pressure over the relieved oil pressure.

Page 28. Paragraph 17a is superseded as follows:

a. Preparation for Starting.

1. Perform daily preventive maintenance services (para 37).
2. Lubricate hot oil heater as specified in LO 5-3895-281-12.
3. Be sure equipment is grounded.
4. Install three-way valve handle.
5. Install and connect liquid transfer hoses.
6. Open exhaust stack rain cap and remove vent pipe plug (para 10).
7. Connect external power source and external fuel source. Check to see if power is available and turn fuel valves at fuel oil strainer to receiving position.

Page 33, paragraph 19.1. Subparagraphs a(2) and a(4) are deleted in their entirety.

Page 38. Paragraph 34 is superseded as follows:

34. General Lubrication Information

Refer to LO 5-3895-281-2 for lubrication instructions for the heater.

Delete paragraph 35b in its entirety.

Page 40. Figure 15 is deleted in its entirety.

Page 44. After item 15, add items 16 and 17 as follows:

16. DAMPER CONTROL LINKAGE AND OPERATING CYLINDER. Inspect for corrosion build-up. Dismantle and clean (para 88).

17. HEATER HULL. Inspect for carbon build-up and deterioration of refractory. If carbon build-up is excessive and/or refractory is deteriorated, notify direct support maintenance personnel.

Page 46. After paragraph 41c, add the following.

NOTE

When replacing the program controller, use the conversion kit 129-65. The original base can still be used by redesignating the terminals. See figure 5A.

Page 61, paragraph 70, line 7. Change "30/60 cycle" to read "3 phase/60 hertz".

Page 72, paragraph 83d3. In line 2, change "is psi" to read "6 to 30 psi".

Page 118, paragraph 133. Line 2 is changed to read: "are listed and illustrated in TM 5-3895-281-25P."

Page 155. Appendix II is superseded as follows:

APPENDIX II BASIC ISSUE ITEM LIST AND ITEMS TROOP INSTALLED OR AUTHORIZED LIST

Section I. INTRODUCTION

1. Scope

This appendix lists basic issue items, items troop installed or authorized which accompany the oil heater and are required by the crew/operator for operation, installation, or operator's maintenance.

2. General

This basic issue items, items troop installed or authorized list is divided into the following sections:

a. *Basic Issue Items List*—Section II. Not applicable.

b. *Items Troop Installed or Authorized List*—Section III. A list in alphabetical sequence of items which at the discretion of the unit commander may accompany the end item, but are NOT subject to be turned in with the end item.

3. Explanation of Columns

The following provides an explanation of columns in the tabular list of Basic Issue Items List, Sec-

tion II, and Items Troop Installed or Authorized, Section III.

a. *Source, Maintenance, and Recoverability Code(s) (SMR)*: Not applicable.

b. *Federal Stock Number*. This column indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

c. *Description*. This column indicates the Federal item name and any additional description of

the item required.

d. *Unit of Measure (U/M)*. A 2-character alphabetic abbreviation indicating the amount or quantity of the item upon which the allowances are based, e.g., ft, ea, pr, etc.

e. *Quantity Authorized (Items Troop Installed or Authorized Only)*. This column indicates the quantity of the item authorized to be used with the equipment.

Section III. ITEMS TROOP INSTALLED OR AUTHORIZED LIST

(1) SMR code	(2) Federal stock No.	(3) Description Ref. No. & Mfr code	Usable on code	(4) Unit of meas	(5) Qty auth
	7520-559-9618 4210-889-2221	CASE, PUBLICATIONS EXTINGUISHER, FIRE		EA EA	1 1

By Order of the Secretary of the Army:

Official:

VERNE L. BOWERS

Major General, United States Army
The Adjutant General

CREIGHTON W. ABRAMS
General, United States Army
Chief of Staff

Distribution:

To be distributed in accordance with DA Form 12-25B, (qty rqr block No. 422) Organizational maintenance requirements for Heaters, Bituminous.

TM 5-3895-281-15

TECHNICAL MANUAL)

NO. 5-3895-281-15)

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., 21 November 1968

OPERATOR, ORGANIZATIONAL, DIRECT SUPPORT,
GENERAL SUPPORT, AND DEPOT MAINTENANCE MANUAL
HEATER, HOT OIL, TRAILER MOUNTED: ELECTRIC MOTOR
DRIVEN, 2,100,000 BTU/HR OUTPUT (HOPKINS MODEL
200STM)

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PART ONE
HOT OIL HEATER
CHAPTER 1
INTRODUCTION

Section 1. GENERAL

1. Scope

a. These instructions are published for the use of the personnel to whom the Hopkins Hot Oil Heater, Model 200STM is issued. Chapters 1 through 5 provide information on the operation, preventive maintenance and organizational maintenance of the equipment, accessories, components and attachments. Chapter 6 provides information for direct and general support and depot maintenance. This manual provides descriptions of the main units and their functions in relationship to other components.

b. Appendix 1 contains a list of publications applicable to this manual. Appendix 11 contains the basic issue item list and maintenance and operating supplies authorized for the initial operation. Appendix 111 contains the maintenance allocation chart.

c. Numbers in parenthesis on illustrations indicate quantity. Numbers preceding nomenclature callouts on illustrations indicate the preferred maintenance sequence.

d. The direct reporting by the individual user of errors, omissions, and recommendations for improving this manual is authorized and encouraged. DA Form 2028 (Recommended Changes to DA Publications) will be used for reporting these improvement recommendations. This form will be completed using pencil, pen, or typewriter, and forwarded directly to the Commanding General, U.S. Army Mobility Equipment Command, ATTN: AMSME-MPP, 4300 Goodfellow Boulevard, St. Louis, Mo. 63120.

e. Report all equipment improvement recommendations as prescribed by TM 38-750.

2. Record and Report Forms

a. DA Form 2258 (Depreservation Guide for Vehicles and Equipment).

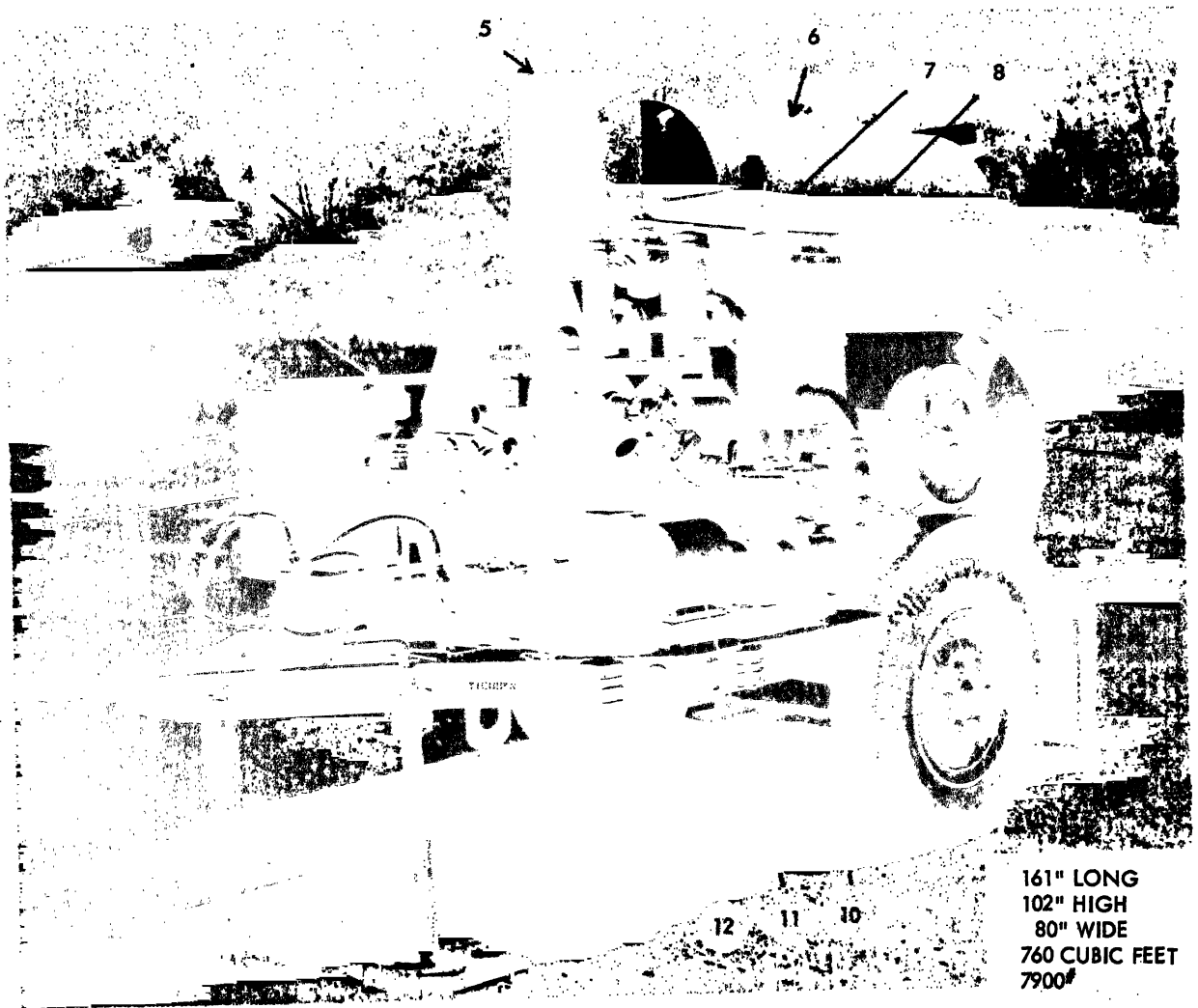
b. For other record and report forms applicable to the operator and organizational maintenance, refer to TM 38-750.

NOTE: Applicable forms, excluding Standard Form 46 which is carried by the operator, will be kept in a canvas bag mounted on the equipment.

3. Description

Section II. DESCRIPTION AND DATA

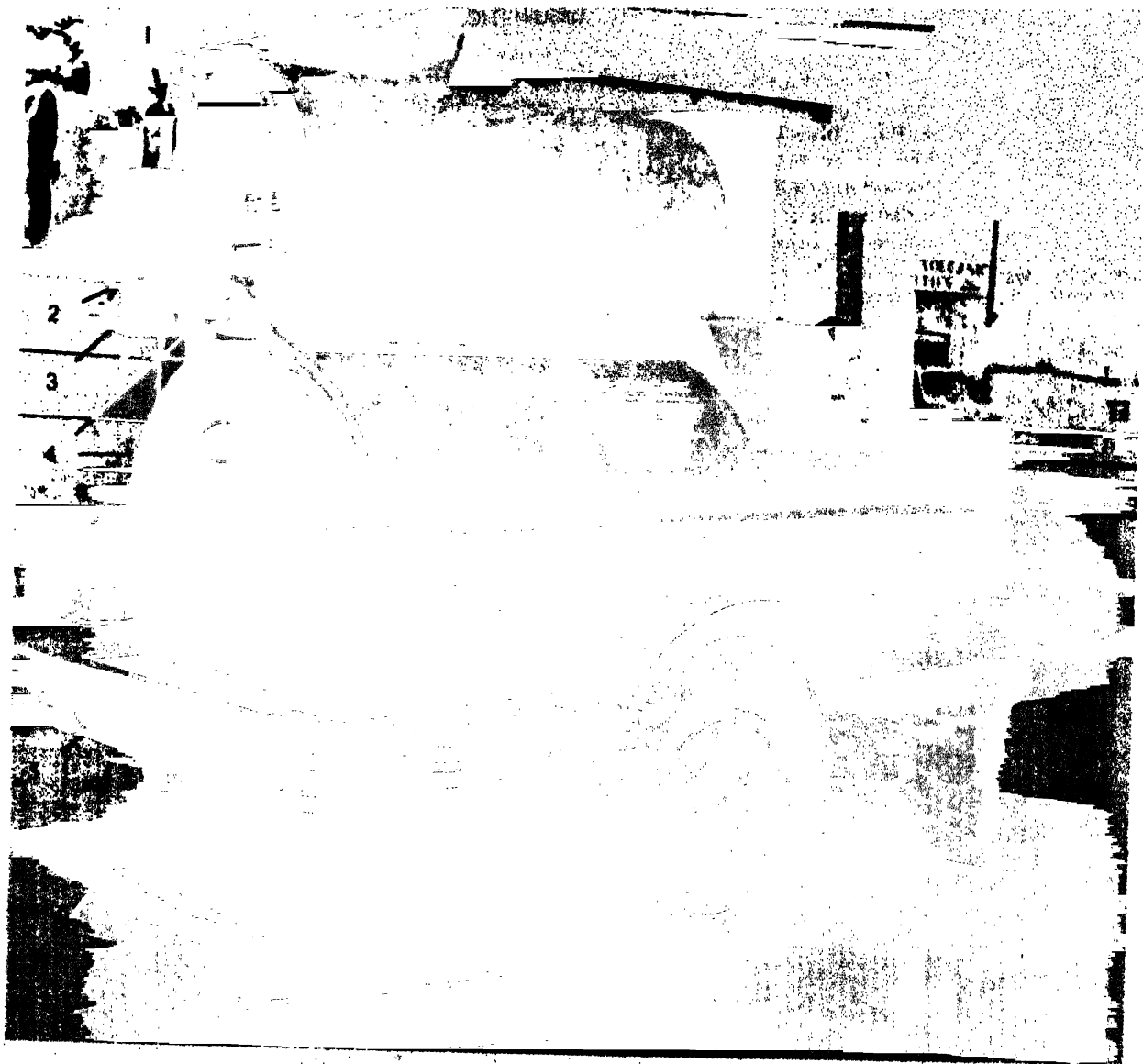
The Hopkins Model 200STM Hot Oil Heater (figs. 1 and 2) is a mobile, heavy duty, high output heater, consisting of the heater unit complete and mounted on a trailer. It normally is used with two asphalt melters operating in parallel or with a heavy duty asphalt plant, and is designed to heat transfer oil and pump this oil to the external systems requiring heat. External electrical power and fuel must be provided for its operation. Power supply should be 3 Phase, 60 cycle, 220 volts and be capable of a 15 Kilowatt load.



LEGEND FOR FIGURE 1

- | | |
|-------------------------------------|---------------------------------|
| 1. Burner | 7. Strainers |
| 2. Control Box | 8. Surge Tank |
| 3. High Temperature Control | 9. Cable Reel |
| 4. Pressuretrol | 10. Hot Oil Pump |
| 5. Stack and Rain Cap | 11. Motor |
| 6. Oil Reservoir and Expansion Tank | 12. Fuel Oil Supply Connections |

FIGURE 1. HOT OIL HEATER, LEFT FRONT THREE-QUARTER VIEW WITH SHIPPING DIMENSIONS



LEGEND FOR FIGURE 2

- | | |
|----------------------|---------------------|
| 1. Vent Pipe | 5. Flame View Sight |
| 2. Cold Seal Tank | 6. Hose Container |
| 3. Sight Gauge | 7. Load Jacks (4) |
| 4. Low Level Control | 8. Control Box |

FIGURE 2 HOT OIL HEATER, RIGHT REAR, THREE-QUARTER VIEW

4. Identification and Tabulated Data

a. Identification. The hot oil heater has Six identification plates.

- (1) U.S. Army. Located on the hull of the hot oil heater on the right front side. Specifies the nomenclature, serial number, serial number range, manufacturer, model and contract numbers, and dimensions.
- (2) Transportation Data Plate. Located on the hull of the hot oil heater on the right front side. Indicates location and capacity of lifting and tiedown attachments on the hot oil heater.
- (3) Burner Plate. Located on the top rear of the burner. Specifies the manufacturer, size, type, serial number, motor and control amperage and firing rate.
- (4) Circulating Pump Plate. Located on the circulating pump housing. Specifies manufacturer, size, serial number, capacity, speed and head pressure.
- (5) Circulating Pump Motor Plate. Located on the pump motor frame. Specifies manufacturer, model, number horsepower, phase, voltage, cycles, revolutions per minute, amperage, heat rise in centigrade, service factor, type of design, frame number, type, code, and bearing parts numbers, grease specifications and connecting diagrams.
- (6) Blower Motor Plate. Located on the blower motor frame. Specifies manufacturer, part number, type, frame type, voltage, form number, phase, insulation class, code, horsepower, amperage, service factor, service factor amperage, revolutions per minute, cycles, thermal protection information, serial number, and operating heat range in centigrade.

b. Tabulated Data

(1) Hot Oil Heater

Manufacturer -----	Hopkins Volcanic Specialties, Inc.
Model -----	200 STM
Type -----	Oil-fired, electric driven, trailer mounted.
Power Requirement -----	15 KW (kilowatts), 220/440 volts, 3 phase, 60 cycle current
Fuel Requirement -----	16 to 26 gph (gallons per hour)
Surge Tank and Reservoir and Expansion Tank	
Capacity (transfer oil) -----	MIL-SYB-LAB- 230 gal.

(2) Burner

Manufacturer & Code No. ----- Power-Flame 30069
Div of Siemon Mfg.
Grandview, Mo.
Model ----- CR2-OS
Type ----- Oil-fired, electric-ignition
Air Requirement ----- 900 cu. ft. (Cubic feet)
per minute
Ignition Requirement ----- 10,000 volts &

(3) Circulating Pump

Manufacturer & Code No. ----- Sier Bath 23761
Div. G & B Mfg.
West Springfield, Kansas
Model ----- C-2 Gearrex
Type ----- Positive Displacement
Horsepower ----- 5.5 BHP
Drive ----- Direct coupling to
electric motor
Operating Speed ----- 1750 rpm (revolutions
per minute)
Operating Pressure ----- 55 psi (Pounds per square
inch)

(4) Circulating Pump Motor

Manufacturer & Code No. ----- Baldor Elec. Co. 05472
St. Louis, Mo.
Model ----- TEFC
Type ----- Induction
Horsepower ----- 7.50
Drive ----- Electric
Power Requirement ----- 208-220/440 volts, 3 phase
60 cycle current.

(5) Fuel Pump

Manufacturer & Code No. ----- Webster Elec. Co. 64294
Racine, Wisconsin
Model ----- 22R-221-0
Type ----- Two stage gear
Drive ----- Direct coupling to
blower motor
Operating Speed ----- 3500
Operating Pressure ----- 250 psi
Adjustment ----- Pressure Adjusting Screw

(6) Blower Motor

Manufacturer & Code No. ----- General Elec. Co. 24446
Ft. Wayne, Ind.
Model ----- 6K47KG746
Type ----- SC two pole, induction
Horsepower ----- 1 1/4
Drive ----- Electric
Power Requirement ----- 220/440 volts, 3 phase,
60 cycle current

(7) Program Controller

Manufacturer & Code no. ----- Electronics Corp. 99680
of America - Cambridge, Mass.
Model ----- UVM-2A
Operating Sequence ----- Preselected and present
Type ----- UV-Solid State
Accessory Requirement ----- Rectifying U.V. Detector
Power Requirement ----- 110 volts, 60 cycle, 1
phase current

(8) Fuses

Manufacturer & Code No. ----- Bussman Mfg. Co. 71400
Div. of McGraw Edison
St. Louis, Mo
Model ----- XP-55
Rating ----- 6 amps (amperes)

(9) Scanner

Manufacturer & Code No. ----- Electronics Corp. 99680
of America - Cambridge, Mass.
Model ----- UVM-1A

(10) Low Fluid Level Cutoff

Manufacturer & Code No. ----- Jo-Bell Prod., Inc. 98347
Oaklawn, Illinois
Model ----- A-255 STD
Type ----- AC
Power Requirement ----- 110 volts, 60 cycle current

(11) Temperature Controller

Manufacturer & Code No. ----- Partlow Corp. 45809
New Hartford, New York
Model ----- MF-27-665KLP-110X3'0
W/143 Acc.
Type ----- AC
Power Requirement ----- 110 volts, 60 cycle current

(12) Pressuretrol

Manufacturer & Code No. ----- Allen-Bradley 01121
Milwaukee, Wisconsin
Model ----- 836-TJ7-FC
Type ----- AC

(13) Temperature Gage

Manufacturer & Code No. ----- Manning, Maxwell 38056
& Moore - Div. of Dresser
Ind. - Stratford Conn.
Model ----- 2-6360MT-04R-025
Model ----- 30-6360BHT-04R-025

(14) Pressure Gage

Manufacturer & Code No.-----Manning, Maxwell 38056
& Moore - Div. of Dresser
Ind. - Stratford, Conn.
Model-----20-1000S-2L

(15) Liquid Level Sight Gage

Manufacturer & Code No. -----Essex Brass Corp. 20969
Detroit, Mich.
Model -----No. 9

(16) Circulating Pump Motor Starter

Manufacturer & Code No.-----Allen-Bradley 01121
Milwaukee, Wisconsin
Model -----709 BOD
Primary voltage -----220 volts, 60 cycle

(17) Ignition Transformer

Manufacturer & Code No.-----Webster Elec. Co. 64294
Racine, Wisconsin
Model -----31225ABC190
Power Requirement -----110 volts, 60 cycle
Type -----Ignition
Operating Voltages:
Primary-----110 volts
Secondary-----10,000 volts

(18) Blower Motor Starter

Manufacturer & Code No.-----Allen-Bradley 01121
Milwaukee, Wisconsin
Model -----709 TOD

(19) High Temperature Cut Off

Manufacturer & Code No. -----Partlow, Inc. 45809
New Hartford, New York
Model -----02-665 BP-110x5'0"
w/ 143 Acc.
Power Requirement -----110 volt, 60 cycle

(20) Burner Oil Valves

Manufacturer & Code No.-----Honeywell, Inc. 40931
Minneapolis, Minnesota
Model-----V4046B 10491
Model-----V4046A 10741
Manufacturer & Code No. -----Automatic Switch 04845
Co. - Madison, N.J.
Model -----8314A41

(21) Pump Switch

Manufacturer & Code No. ----- Furnas Elec.Co. 23826
Batavia, Illinois
Model ----- BJS1A Selector Operator
BJK Contact Block

(22) Burner Switch

Manufacturer & Code No. ----- Furnas Elec. Co. 23826
Batavia, Illinois
Model ----- BJS1A Selector Operator
BJK Contact Block

(23) Control Transformer

Manufacturer & Code No. ----- Dongan Elec. Mfg. 18284
Co. - Detroit, Mich.
Rating ----- .350 VA
Primary Voltage ----- 3/60/220
Secondary Voltage ----- 1/60/110

(24) Liquid Transfer Hose

Manufacturer & Code No. ----- Penn. Flexible 77218
Metallic Tubing - Paoli, Pa
Model ----- MIL-H-18160
Diameter ----- 2 inches, inside diameter
Length ----- 8 feet
Number ----- 4

(25) Fuel Oil Strainer

Manufacturer & Code No. ----- Purolator Prod., Inc 81321
Rahway, New Jersey
Model Numbers:
Fuel Oil Strainer ----- PF2002
Filter Element ----- PF200
Number -----

(26) Hot Fluid Strainer

Manufacturer & Code No. ----- Hopkins Volcanic - 82370
Spec., Inc. Alliance, Ohio
Model Numbers:
Hot Fluid Strainer ----- A288
Basket Strainer ----- A288
Number ----- 2

(27) Performance Data

Hot Oil Heater Output ----- 2,100,000 British Thermal
Units Per Hour (BTU's)
Hot Oil Heater Operating Temperature ----- 450° F.
Hot Oil Heater Maximum Temperature ----- 475° F.
Hot Oil Heater Fuel Pump Output ----- 30 gpm

Circulating Pump Output -----	113.8 gallons per minute
Blower Output -----	900 cubic feet/minute
Fuel Strainer Output -----	100 gpm
Hot Oil Strainer Output -----	180 gpm
Hot Oil Heater Travel speeds:	
Highways -----	up to 35 miles per hour
Cross Country -----	up to 10 miles per hour
Hot oil Heater Ground Clearance (Trailer Mounted) -----	16 inches

(28) Tires (Trailer)

Manufacturer & Code No. --(Original Mfg. Firestone Tire)	United Co-Op Alliance, Ohio
Size -----	9:00 x 20
Specification -----	MS35388-17
Tube Specification-----	MS35392-13

(29) Brakes (Trailer)

Manufacturer & Code No. -----	Bendix Corp.	14892
	Brake & Steering Div.	
	South Bend, Indiana	
Size -----	13 x 2 1/2" Bendix	
Model -----	LH 320229	
Model -----	RM 320320	

(30) Spring Assembly (Trailer)

Manufacturer & Code No. -----	United Mfg.	95026
	Cleveland, Ohio	
Model -----	1640-1	
Number -----	2	
Capacity -----	10,000#/Pr.	

(31) Axle Assembly (Trailer)

Manufacturer & Code No. -----	United Mfg.	95026
	Cleveland, Ohio	
Model -----	K-96-3	
Number -----	1	
Capacity -----	10,000#	

(32) Hub and Drum Assembly

Manufacturer & Code No. -----	United Mfg.	95026
	Cleveland, Ohio	
Model -----	K-96-30	
Model -----	K-96-30	
Number -----	1 each	

(33) Wheel Bearings

Manufacturer & Code No. -----	Timken Roller -	60038
	Bearing - Canton, Ohio	
Bearing Cone - Outer -----	39585	
Bearing Cone - Inner -----	39580	

(34) 3-Way Solenoid

Manufacturer & Code No. ----- Automatic Switch 04845
Co. - Madison, N.J.

(35) Lovejoy Coupling

Manufacturer & Code No. ----- Flexible Coupling 75665
Chicago, Illinois

(36) Shipping Dimensions & Weight

Refer to figure 1 for shipping dimensions and weight

(37) Air Hydraulic Brake Schematic

Refer to figure 3 for the air hydraulic schematic

(38) Clearance Lights and Trailer Wiring Diagram

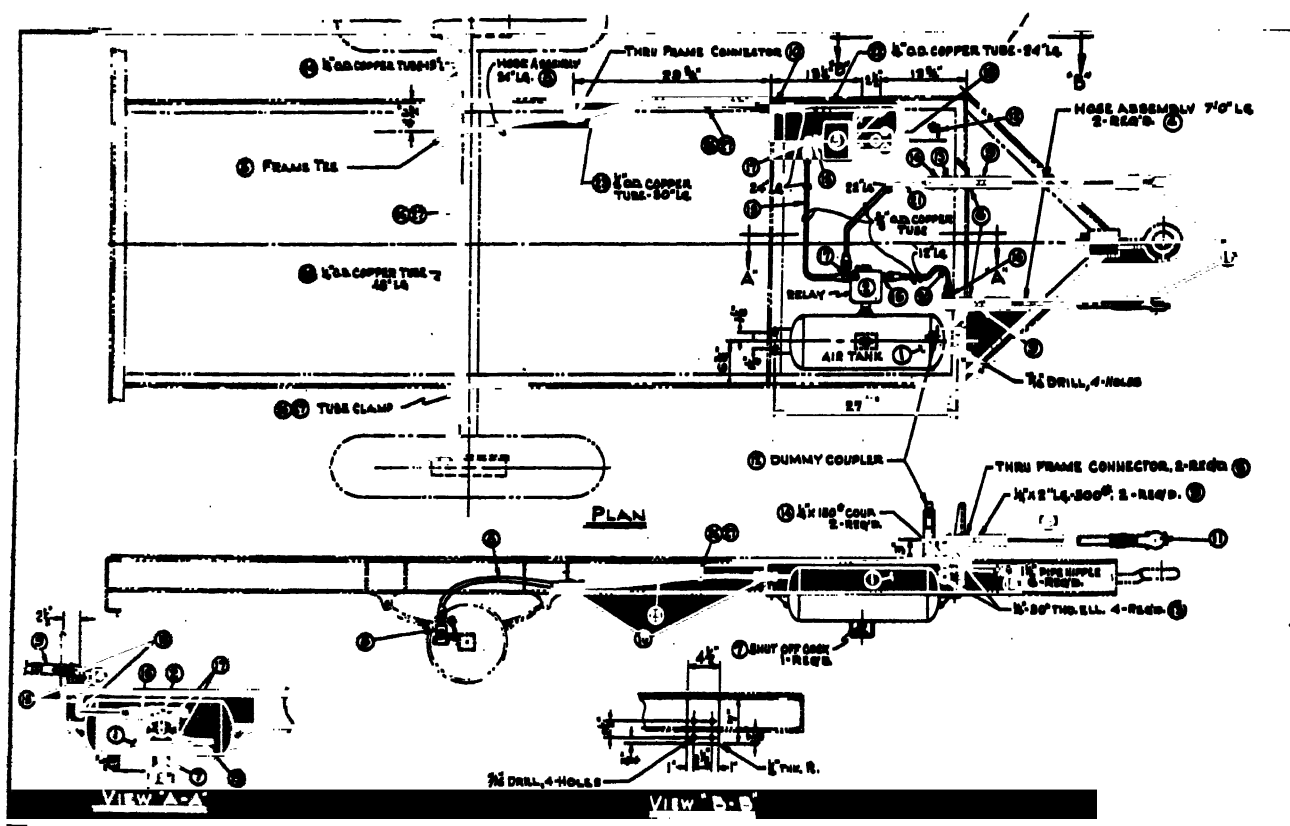
Refer to figure 4 for the clearance lights and trailer practical wiring diagram.

(39) Hot Oil Heater Wiring Diagram

Refer to figure 5 for the hot oil heater practical wiring diagram.

5. Difference in Models

This manual covers only the Hopkins Model 200STM Hot Oil Heater.



		Part No.	No. Required
1	Air Tank	AE 37757	1
2	Relay	AE 37757	1
3	Power Cluster	AE 838	1
4	Hose Assembly - 7'-0" lg.	AD 2600	2
5	Frame Tee (For 1/2" O.D. Tubing)	FC 3933	1
6	Thru Frame Connector (For 1/2" Pipe Fittings)	Std.	2
7	Shut Off Cock	AC 2091	1
8	Hose Assembly (1/2" x 24" lg.)	129-203	1
9	Pipe Coupling (1/2 x 2" lg. - 300#)	Std. Pipe	2
10	Thru Frame Connectors (For 1/2" O.D. Tubing)	4MBTX-8	1
11	Hose Coupler (Glad Hand) R.&L. Hand	AC 3347	2
12	Dummy Coupler for Glad Hand	AD 2583	2
13	Pipe El - (1/2" x 90°)	Std. Pipe	4
14	Pipe Coupling (1/2 x 150#)	Std. Pipe	2
15	Mipple (1/2" x 1 1/4" lg.)	Std. Pipe	6
16	Straight Connector (3/8" O.D. Flare to 1/4" Pipe)	AC 2569	3
17	Tubing Connector (3/8" O.D. x 90°)	AC 2577	3
18	Tubing Connector (1/2" O.D. x 90°)	4CBTX-8	1
19	Tubing (3/8" O.D. x 24" lg. Female Fitting each end)	Copper Tubing Flared	1
20	Tubing (3/8" O.D. x 12" lg. Female Fitting each end)	Copper Tubing Flared	1
21	Tubing (3/8" O.D. x 22" lg. Female Fitting each end)	Copper Tubing Flared	1
22	Tubing (1/4" x 24" lg. Male Fitting each end)	Copper Tubing Flared	1
23	Tubing (1/4" x 30" lg. Male Fitting each end)	Copper Tubing Flared	1
24	Tubing (1/4" x 15" lg. Male Fitting each end)	Copper Tubing Flared	1
	Tubing (1/4" x 48" lg. Male Fitting each end)	Copper Tubing Flared	1
	Tube Clamp 1/4"	2-314	3
	Self Tapping Screws #6 x 3/8 Pan Head	2-419CA	3

VIR-HYDRAULIC SCHEMATIC DRAWING TRAILER

CHAPTER 2

INSTALLATION AND OPERATION INSTRUCTIONS

Section 1. SERVICE UPON RECEIPT OF EQUIPMENT

6. Unloading the Equipment

a. **Shipment by Tractor.** When the hot oil heater is received by tractor, tow it to its destination.

b. **Shipment by Rail.**

1. **Blocking and tiedown removal.** The operator and organizational maintenance personnel will remove tiedown cables, strapping, blocking, cribbing, and other items used for securing the equipment during rail shipment. (Figure 6).
2. **Ramp Unloading.** Block the flatcar wheels and construct a suitable ramp at the end of the railway flatcar. Connect a towing vehicle to the trailer, raise the stabilizing jacks (Fig. 2) and tow the hot oil heater from the flatcar.

CAUTION: BE SURE HOT OIL HEATER HAS SUFFICIENT CLEARANCE BEFORE UNLOADING.

c. **Lifting Hot Oil Heater.** Refer to figure 7 and remove the hot oil heater from the flatcar.

WARNING: LIFT AND TIEDOWN MOUNTED HOT OIL HEATER BY TRAILER LIFTING AND TIEDOWN ATTACHMENTS ONLY.

WARNING: DO NOT USE A LIFTING DEVICE WITH A CAPACITY OF LESS THAN 10,000 POUNDS TO LIFT THE TRAILER MOUNTED HOT OIL HEATER. DO NOT ALLOW THE UNIT TO SWING OR SWAY WHILE SUSPENDED. FAILURE TO OBSERVE THIS WARNING MAY RESULT IN INJURY OR DEATH TO PERSONNEL.

7. Unpacking the Equipment

a. **Unpacking.** The hot oil heater is shipped unpacked, ready for operation upon arrival.

b. **Removal of Protective Material and Devices.** Remove all tape or barrier materials from the gages, identification and instruction plates, controls, and instruments located on the hot oil heater.

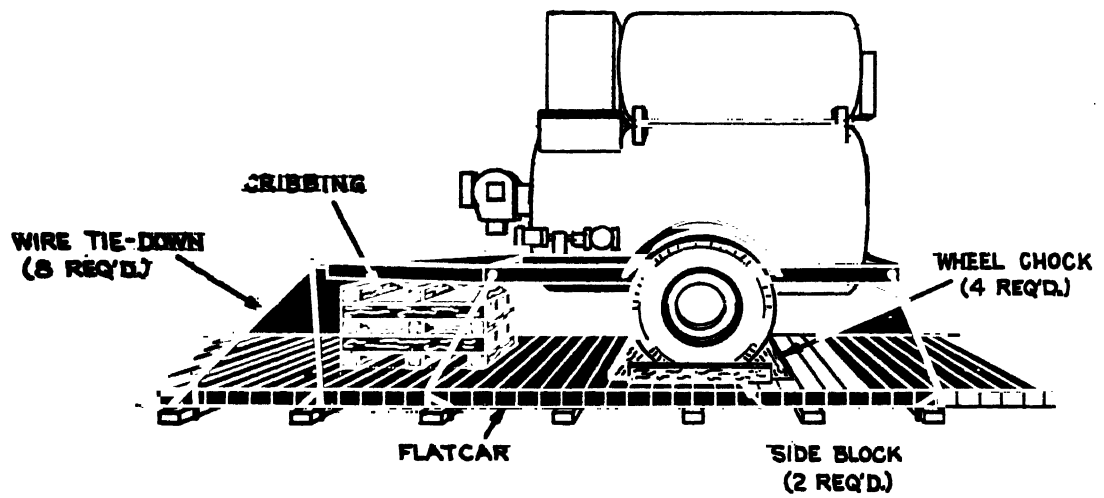


FIGURE 6. HEATER ON FLAT CAR, BLOCKED AND CRIBBED

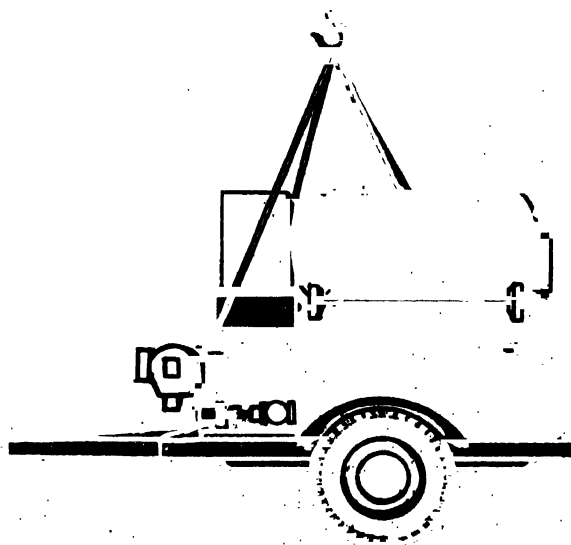


FIGURE 7. TRAILER UNLOADING BY CRANE

8. Inspecting and Servicing the Equipment

a. Inspection

1. Prepare the hot oil heater for inspection and operation as outlined in DA Form 2258 (Depreservation Guide for Vehicles and Equipment) attached on or near the operational controls.
2. Carefully inspect the hot oil heater for missing parts and possible damage that may have occurred during shipment.
3. Inspect the hot oil pressure gage, hot oil temperature gage and liquid level sight gage for broken glass or other damage.
4. Inspect all wiring and conduits for broken or damaged wiring or loose connections.
5. Inspect the fuel oil strainers, fuel oil lines, blower, blower motor and linkage for breakage, cracks or loose mountings.
6. Inspect the control box, U.V. cell, and igniter transformer for possible damage. Unpack the flame program control and install in mounting base.
7. Inspect the hot fluid filter, three way valve, hot fluid piping, circulating pump and circulating pump motor for possible damage.
8. Inspect the relief valve, supply valve, fill valve, make up valve and pump valve for possible damage and freedom of operation.
9. Correct the deficiencies noted or report the condition to direct support.

b. Servicing:

1. Perform the daily preventive maintenance steps as listed in paragraph 37.
2. Lubricate the hot oil heater in accordance with the current lubricating order.

9. Installation of Separately Packaged and Packed Components.

a. **External Power Source Service Cable.** The external power source service cable is used to connect the hot oil heater to its source of electrical power, usually a generator set. Refer to figure 8 and install the external power source service cable.

b. **Three-Way Valve Handle.** The three-way valve handle normally is stored in the toolbox when not in use. Its purpose is for the control of the two three-way valves (selectro valves) on the hot oil heater. Refer to Fig. 8 and install the three-way valve handle.

c. **Grounding Rod.** The grounding rod should be installed before the equipment is put into operation and should not be removed until the equipment is prepared for movement. Refer to Fig. 8 and install the grounding rod.

d. Liquid Transfer Hoses. The four liquid transfer hoses are used to connect the hot oil heater with the external system requiring heat. They can be used singly or linked together according to the individual application. Two separate liquid transfer hose systems must be installed: one to carry the heated transfer oil to the external systems, and one to return the cooled oil to the hot oil heater for reheating. Refer to Fig.8 and install the liquid transfer hoses.

LEGEND FOR FIGURE 8.

- | | |
|--------------------------------------|---------------------------------------|
| 1. Ground Rod (completely assembled) | 11. Burner Switch |
| 2. Ground Rod (disassembled) | 12. Pump Switch |
| 3. Ground Cable | 13. External Power Plug-in Connection |
| 4. Liquid Transfer Hoses (4) | 14. Ground Rod Cable Connection |
| 5. Power Adapter Cable Assembly | 15. Unions (4) |
| 6. Fuses - 6 Amp (4) | 16. Ground Rod Cable Clamp |
| 7. Burner Nozzles (4) | 17. 3-Way Valve Handle |
| 8. Over-Pack Kit | 18. Burner Electrodes (2) |
| 9. Instructions Manual | 19. Intervehicular Harness |
| 10. Relief Valve | |

LEGEND FOR FIGURE 8A.

- | | |
|-------------------------------|----------------------|
| 1. Coupling Ground Mtg. Bolts | 10. Surge Tank |
| 2. Pump Motor Mtg. Bolts | 11. Makeup Valve |
| 3. Fill Valve | 12. Surge Tank Drain |
| 4. Supply Valve | 13. Pump Valve |
| 5. Pressuretrol | 14. Cable Reel |
| 6. Strainers | 15. Chock Block |
| 7. 3-Way Valve Handle | 16. Pump |
| 8. 3-Way Valve | 17. 100 Foot Cable |
| 9. Emergency Fill | |

10. Installation or Setting Up Instructions.

a. General. The hot oil heater operates in conjunction with several other units to accomplish its purpose, which is to supply heat for the heating of liquids. It requires an external power source and external fuel supply. Using the liquid transfer hoses, a closed circulating system must be set up between the hot oil heater and the external system requiring heat to carry the heated transfer oil to the external system and return it to the hot oil heater for reheating. The hot oil heater should be installed and operated on a level site and with adequate ventilation.

WARNING: DO NOT OPERATE THE HOT OIL HEATER IN AN ENCLOSED AREA
UNLESS THE EXHAUST GASES ARE PIPED TO THE OUTSIDE.
INHALATION OF EXHAUST FUMES CAN RESULT IN SERIOUS
ILLNESS OR DEATH.

b. Installation.

1. Grounding Rod. Refer to Figure 8 and install the grounding rod.

WARNING: DO NOT OPERATE THE HOT OIL HEATER UNTIL IT HAS BEEN GROUNDED.
ELECTRICAL FAULTS IN THE POWER SOURCE, LOAD LINES, OR THE
BURNER AND ELECTRICAL SYSTEM CAN CAUSE DEATH BY ELECTROCUTION
WITH AN UNGROUNDED SYSTEM.

2. Liquid Transfer Hoses. Refer to Figures 8 and 9 and install the liquid transfer hoses.
3. Filling the Surge Tank and Reservoir and Expansion Tank. Refer to preventive maintenance services (Para. 37) for location and procedure to service the surge tank and reservoir and expansion tank. Refer to identification and tabulated data (Para. 4) for heat transfer oil capacity and fill the surge tank and reservoir and expansion tank. The cold seal tank (Fig. 2) must have an oil level of $2\frac{1}{2}$ " to form an effective seal and prevent breakdown of transfer oil. It is an eliminator and collector of moisture from the complete system during operation. It must be drained periodically and new transfer oil added at crossover line from reservoir expansion tank to maintain its effective use.
4. Exhaust Stack Rain Cap and Vent Pipe Plug. Open the exhaust stack rain cap (Fig. 2) and remove the vent pipe plug at top of cold seal tank (Fig. 1). The rain cap should remain open and the vent pipe plug removed during the operation of the hot oil heater.

WARNING: OPEN THE HINGED RAIN CAP ON THE EXHAUST STACK AND REMOVE
THE VENT PIPE PLUG FROM THE VENT PIPE ASSEMBLY AS PRESSURES
WILL BUILD UP DURING OPERATION CAUSING AN EXPLOSION WHICH
COULD CAUSE INJURY TO PERSONNEL AND DAMAGE TO THE EQUIPMENT.

5. External Power Source. Refer to Fig. 8 and install the external power source service cable.
6. External Fuel Source. Refer to Figs. 10 and 11 and install the external fuel source connection.

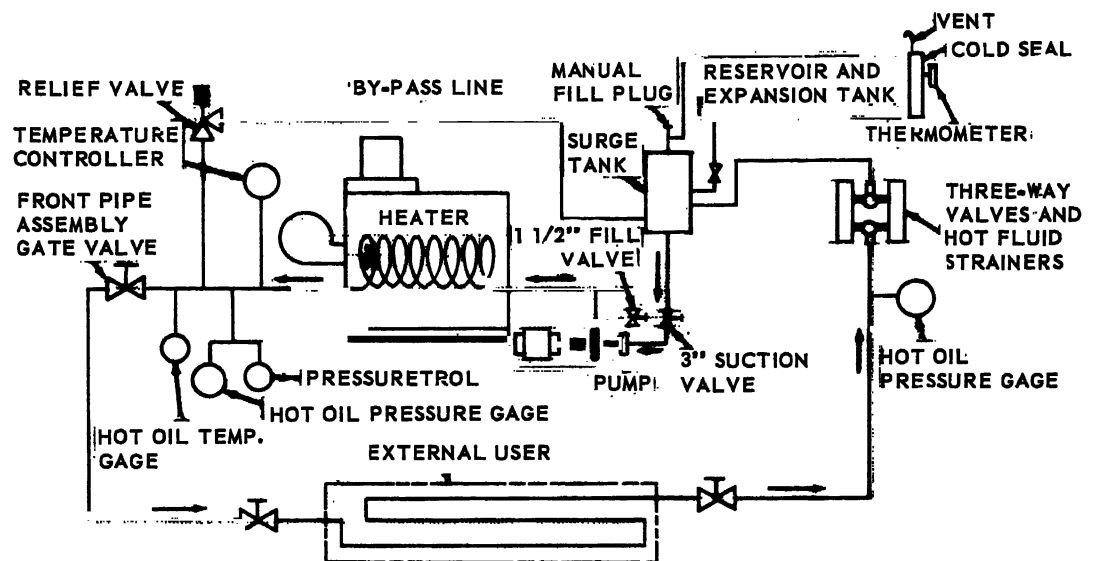


FIGURE 9. HOT FLUID FLOW DIAGRAM

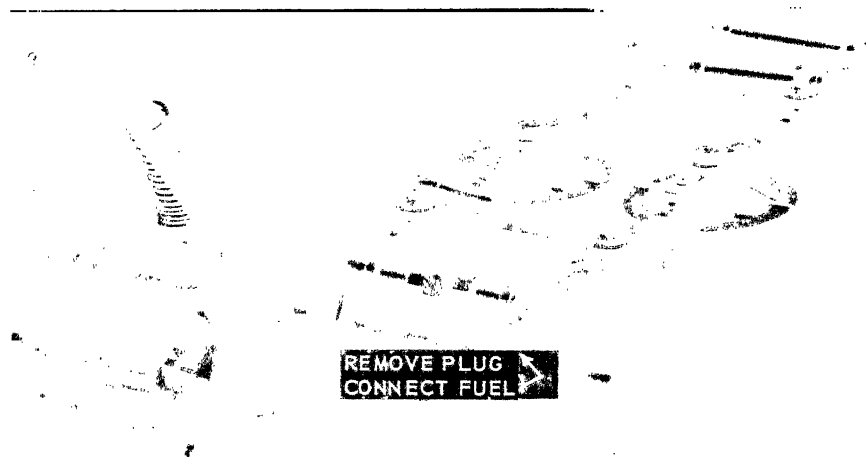


FIGURE 10. EXTERNAL FUEL SOURCE CONNECTION

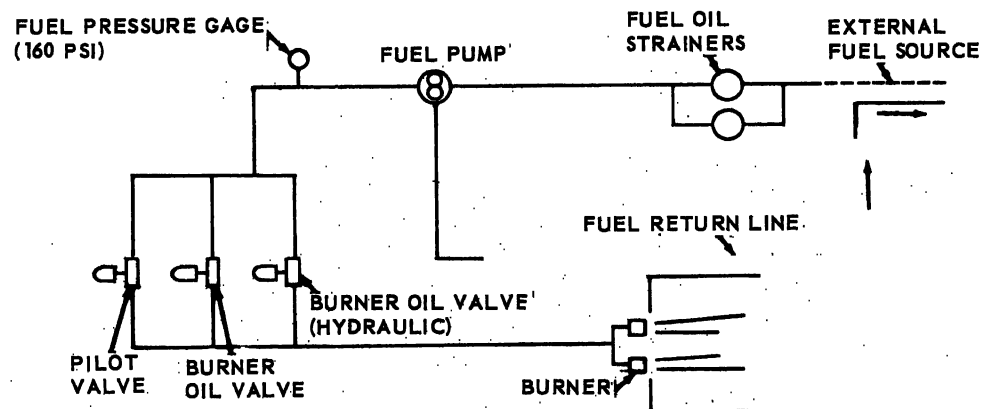


FIGURE 11. FUEL OIL FLOW DIAGRAM

Section II. MOVEMENT TO A NEW WORKSITE

II. Dismantling for Movement

- a. Close all valves on the hot oil heater.
- b. Remove the external fuel source connection and the external power source service cable.
- c. Close the exhaust stack rain cap and install the vent pipe plug.

WARNING: DO NOT DISCONNECT ANY COUPLINGS, PIPING, OR HOSES WHEN HEAT TRANSFER OIL TEMPERATURE IS HIGHER THAN AMBIENT TEMPERATURE AS SERIOUS BURNS COULD RESULT FROM SPILLED OR SPRAYED HEAT TRANSFER OIL.

- d. Remove the liquid transfer hoses.
- e. Remove the grounding rod.

12. Movement to a new Worksite.

The hot oil heater is mounted on a trailer and may be towed to a new worksite or shipped by railroad flatcar.

13. Reinstallation After Movement.

Refer to paragraph 10 for installation procedures.

Section III. CONTROLS AND INSTRUMENTS

14. General

This section describes, locates, illustrates, and furnishes the operator, crew, or organizational maintenance personnel sufficient information about the various controls and the instruments for operation of the hot oil heater.

15. Controls and Instruments

Refer to Fig. 12 for location, purpose, and normal readings of all controls and instruments.

Section IV OPERATION OF EQUIPMENT

16. General

a. The instructions in this section are published for the information for guidance of the personnel responsible for the operation of the hot oil heater.

b. The operator must know how to perform every operation of which the hot oil heater is capable. This section gives instructions of starting and stopping the hot oil heater, and how to perform the specific tasks for which the equipment is designed. Since nearly every job presents a different problem, the operator may have to vary given procedures to fit the individual job.

17. Starting and Stopping Instructions.

a. Preparation for Starting.

1. Perform the daily preventive maintenance services (Para. 37).
2. Lubricate the hot oil heater as specified in the current lubrication order.
3. Be sure the hot oil heater is properly grounded. (Para. 10).
4. Install the three-way valve handle. (Para. 10).
5. See that the liquid transfer hoses are properly installed and connected. (Para. 10).
6. Open the exhaust stack rain cap and remove the vent pipe plug. (Para. 10).
7. See that the external power source and the external fuel source are connected, that power is being received and turn the fuel valves at the fuel oil strainer to the receiving position. (Para. 10).
8. Refer to Fig. 12 for manual transfer oil valve settings, after adjusting valve turn main pump switch to "ON" position.
9. After main pump is operating and pressure is steady, turn burner switch to "ON". Burner will start automatically.

WARNING: DO NOT OPERATE THE HOT OIL HEATER IN AN ENCLOSED AREA UNLESS THE EXHAUST GASES ARE PIPED TO THE OUTSIDE. INHALATION OF EXHAUST FUMES CAN CAUSE SERIOUS ILLNESS OR DEATH.

NOTE: An uninterrupted flow of transfer oil through the hot fluid filters is possible only if the arrows on the flow indicating collars are properly positioned. The three gate valves are opened by turning the wheels fully counterclockwise.

WARNING: USE GLOVES FOR OPERATION AS THE HIGH OPERATING TEMPERATURE OF THE HOT OIL HEATER COULD CAUSE SERIOUS BURNS.

WARNING: STAND CLEAR OF VENT PIPE DURING OPERATION AS INTERNAL PRESSURES MAY CAUSE MINOR ERUPTIONS OF HOT FLUID WHICH MAY SPRAY THE IMMEDIATE AREA.

c. Stopping.

1. Refer to Fig. 8 and turn burner switch to "OFF" position.
2. Return all manual switches to "OFF" position.
3. Perform the daily preventive maintenance services. (Para. 37).

A. Starting

- Step 1.** Using the three-way valve handle (Para. B. Stopping) refer to the arrows on the flow direction indicating collars, and the three-way valves for the use of one or the other hot fluid strainer.
- Step 2.** Open front pipe assembly gate valve and pump suction gate valve.
- Step 3.** Open the control box.
- Step 4.** Set temperature control located in control box to desired temperature.
- Step 5.** Turn main pump switch to "ON".
- Step 6.** After good circulation is established turn burner switch to "ON".

B. Stopping

- Step 1.** Turn burner switch to "OFF" position.
- Step 2.** Allow oil to circulate until temperature reaches 250° F.
- Step 3.** Turn circulating pump switch to "OFF" position.
- Step 4.** Close the return oil valve located on the strainer assembly.
- Step 5.** Close and secure control box.
- Step 6.** Do not leave flammable materials open and unguarded in the area. This constitutes a real fire hazard.

18. Operation of the Hot Oil Heater.

a. **Theory of Operation.** The theory of operation of the hot oil heater once the unit is installed, and preoperations inspections and adjustments have been made, requires minimum activity, but careful observation on the part of the operating personnel. The operator sets the heating requirements on the temperature controller (Fig. 12) and starts the heater. From this point on, the sequence of operation is controlled by the program controller located in the control box. The operation is fully automatic and involves all of the components of the burner operating system, with a check and balance, safety factor, method of procedure. The circulating pump motor starter supplies the flow of electrical current to the various components. When dangerous conditions or malfunctioning exist, safety devices throughout the system cause the unit to shut down operations. The operator observes the operation of the mechanism and the burner flame and adjusts heat limits if necessary. The operator can also stop the hot oil heater in an emergency. Emergency stopping by the operator is accomplished by returning the burner switch to the "OFF" position.

b. **Sequence of Operation.** After the activation of the program controller (Para. 18, a above), the automatic sequence of operation is as follows:

- 1. The burner controls and mechanisms move into the prepurge stage, during which the blower operates to scavenge all ash, dust, unburned oil vapors, and residue from the combustion chamber. The prepurge period has a duration of approximately thirty seconds.

2. Following the prepurge, the control energizes the pilot valves and ignition transformer. There is a 12 second period of trial for ignition. If the burner does not ignite, the burner shuts off on safety. With ignition the low fire valve opens and the oil cylinder drives the air damper to the high fire position. The damper will remain in the high fire position until the temperature requirement is reached.

3. When the temperature controller indicates that the required temperature has been reached, the low fire and high fire valves close, the burner flame is extinguished, oil cylinder returns the air damper to the closed position at which time the unit goes into standby, then only the circulating pump motor is operating the pump to circulate the heated transfer oil.

4. Burner mechanism remains on standby until temperature drops, and then restarts the heating cycle.

5. If there is a flame failure during the period in which the burner is in operation, the air damper will return to the low-fire position, the flame program control will return to prepurge for approximately 30 seconds. After the prepurge, there will be a trial ignition lasting 12 seconds. If there is no flame detected at this time, the flame program control will go into flame failure safety, and can be restarted only after depressing the red reset button located in its cover.

START UP

1. Check expansion tank and external user to be sure that system is filled. If more oil is needed add heat transfer oil complying to MIL-L-22851 Type 3.
2. Check all connections for tightness of joints to protect against leakage.
3. Check that proper valves are open to provide oil circulation.
4. Connect 3/60/220V Power Supply.
5. Check rotation of motors, rotation is indicated by an arrow on pump and burner housing.
6. Turn on main circulating pump. When pressure is steady at about 55 PSI on pump discharge, open fuel valves.
7. Set temperature control to desired temperature.
8. Turn burner switch "ON" when fuel pressure is established, burner will ignite; and continue fully automatic to satisfy demand for heat.
9. Observe flame through observation port at rear of heater, flame should be clean, not smoky. observe exhaust stack, stack should have light haze, not smoky.

STOPPING THE HEATER

1. Turn burner switch "OFF"
2. Close manual fuel valves.

3. Allow main circulating pump to operate until temperature of circulating oil has dropped to 275° F. as indicated by thermometer at heater front.

4. Turn pump switch "OFF".

Before leaving the heater make sure there are no flammable materials left open or spread around the area.

Heating with the Hot Oil Heater.

There are many conditions which arise outside the heat exchanger, which can cause poor heat transfer through an external user to the hot oil heater.

1. Air trapped in piping and tanks will sometimes move into the oil stream causing the following conditions. The pump will become noisy, the sound will give you the impression that there are stones or foreign objects in the pump. This condition is called cavitation. The pressure gages will fluctuate wildly and the flexible lines on the return to the strainer will jump about. The pressure gage at the heater discharge will register above its normal operating pressure of about 55 PSI, because the pump is actually trying to compress this air trapped in the lines. The air may be vented by removing the 2" pipe plug, located in the expansion line above the surge tank. Small amounts will work out through the vent in the cold seal tank. The chief cause of air entering the system is usually because the system is improperly filled. Therefore, make certain the fluid level in the expansion tank is equal to or above the line stenciled on the tank end, behind the sight glass. If the air continues to enter the system during operation, check all pipe joints to the pump suction, to see that they are tight and not leaking.

2. Water will enter the system due to condensation after a unit has been shut down for a prolonged period, or due to water in any makeup oil put in the system. When water is present in the system, the hot oil lines will create a popping or sizzling sound. If the presence of water is detected, it is wise to lower the temperature to 250° F. until the water is boiled out and vented as a vapor. It is also suggested upon starting after a prolonged shutdown, the unit be operated for an hour or so at a temperature of 250° F. before going on up to the operating temperature.

3. Valving.

There are four operating valves located on the hot oil heater. They are identified as follows: Supply valve - located on the heater front, pump valve - located above the pump, on the pump suction, makeup valve - located in a 1-1/2" line from the expansion tank, entering the surge tank above the pump valve. Fill valve mounted between the pump valve and pump, with one end threaded for filling system from an external source. In normal operation the pump valve is full open and the supply valve is full open. To remove oil from the expansion tank, open the makeup valve.

Observe the oil level to see that it doesn't drop below the line stenciled on the tank head. To add oil to the system, connect the fill valve to a drum with a rubber hose or suitable connection, with one end submerged to the bottom of a drum of oil. Throttle the pump valve and open the fill valve at the same time. Leave the valves this way until the drum is empty, then close the fill valve and open the pump valve to change drums. If the system is in operation, let the pump run, but if the system is not in operation, turn the pump switch off while changing drums

The valves on the external user should be operated as follows:

The supply valve should remain full open. You should throttle the return valve to control the temperature. To reduce the temperature, throttle the valve to close, but never close completely. To raise the temperature, open the valve. When the temperature is close to the desired amount, you should move the valve handle approximately 1/2 turn at a time.

Allow approximately one half hour between adjustments to allow for heat balance.

4. If the stack of the heater should become smoky, this is caused either by not enough air, or too much oil. In either case, there will not be a good heat release and heating will be poor. This condition should be cleared up as soon as possible by either increasing the air or limiting the oil going into the burner.

C. OPERATION

1. Preparation for operation

- a. Starting the Hot Oil Heater (Para. 17).
- b. Inspect for proper rotation of the circulating pump and the blower motor. Correct rotation if necessary. (Para. 91 and 94).
- c. Inspect for proper fuel pressure. Adjust the fuel pump if necessary. (Para. 45).
- d. Inspect the air damper cylinder linkage for proper adjustment. Adjust the damper cylinder linkage if necessary. (Para. 88).
- e. Inspect the electrodes for proper electrode adjustment. Adjustment should be made on the electrodes if necessary. (Para. 103).
- f. Stop the hot oil heater. (Para. 17).

2. Operation. Refer to Fig. 14 to operate the hot oil heater.

19. Operation in Extreme Heat.

- a. Indoor Ventilation. If the hot oil heater is operated indoors or in an enclosed area, allow sufficient room around the equipment for air circulation and ventilation of the area.

NOTE: Various units in the control box will not function properly above 115° F. Make provision to keep control box operating in an ambient temperature of 115° F. or less.

- b. Lubrication. Refer to the current lubrication order and detailed lubrication instructions. (Para. 35)

19.1 Start-Up of Hot Oil Heater In Cold Weather

- a. When heat transfer oil is viscous because of low ambient temperature the thermal overloads on pump starter (Fig. 12) will safety out. Push reset button (Fig. 25) and remedy as follows:
1. Back off relief valve Fig. 8 as low as possible. This will relieve pumping pressure and return oil to expansion tank.
 2. Make sure that the pressuretrol controller Fig. 28 is also backed off with adjusting screws so the electrical circuit is also completed.
 3. Turn on burner switch Fig. 8 and fire heater at intervals of 1-1½ minutes until heat transfer oil has enough heat to lower viscosity and start to circulate through system.
 4. If thermal overloads in main pump starter go into safety without being able to fire heater then block in the auxiliary contactor with a wood wedge. (Caution - This is only to be done in an emergency).
 5. After circulation is established throughout system readjust relief valve so that 50 PSI shows on the pressure gage Fig. 12 and remove any blocks on starters and resume normal operation.

20. Operation in Dusty or Sandy Areas.

- a. Protection. Shield blower motor intake, blower intake, circulating pump and circulating pump motor from dust. Seal the case edge openings of

units such as the temperature controller, low fluid level cutoff, pressuretrol, control box, U.V. cell, and end switch.

CAUTION: DO NOT SEAL THE BLOWER INTAKE SO CLOSELY AS TO PREVENT FILTERED AIR FROM ENTERING.

- b. **Fuel.** See that the fuel is strained before it is put into the external system. Service the fuel strainers frequently to remove sand and dust.
- c. **Lubricants.** Clean the lubrication points before applying lubricants.

21. Operation Under Rainy or Humid Conditions.

- a. **Electric switches, contacts, and terminals** corrode and rust easily under rainy or continued humid conditions. Keep electrical components clean and free of moisture .
- b. If unit is outside and not operating, cover the controls, instruments, electrical components, and the circulating pump motor and adjacent junction box. Remove covers during dry periods.

22. Operation in Salt Water Areas.

- a. **General.** Wash unit frequently with clean, fresh water. Do not contaminate the fuel system or damage electrical equipment.
- b. **Protection.** Coat exposed metal surfaces with rustproofing material. Remove rust immediately and apply paint and/or oil as applicable.

23. Operation in Rough Terrain.

- a. Position the hot oil heater as nearly level as possible.
- b. Be sure the circulating pump is positioned at the lowest level of operation of the hot oil heater.

NOTE: IT IS RECOMMENDED, THAT THE TEMPERATURE OF THE HEAT TRANSFER OIL BE RAISED GRADUALLY TO MEET HEAT REQUIREMENTS STARTING AT AMBIENT TEMPERATURE, RESET THE TEMPERATURE CONTROLLER IN 100° INCREMENTS AFTER EACH HEATING CYCLE UNTIL MAXIMUM DEMAND HEAT IS ATTAINED.

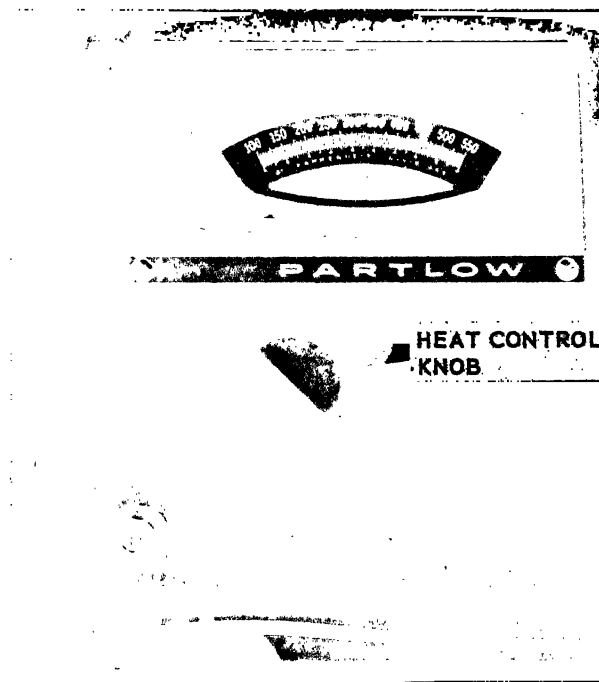


FIGURE 14. HOT OIL TEMPERATURE CONTROLLER

- Step 1. Using the heat control knob, set the heat requirements for the hot oil heater.**
- Step 2. Start the hot oil heater. (Para. 17).**
- Step 3. Monitor the automatic operation of the hot oil heater.**
- Step 4. When heat requirements have been met and the heating operation is concluded, stop the hot oil heater. (Para. 17).**

Section V. OPERATION OF AUXILIARY MATERIAL
USED IN CONJUNCTION WITH THE
EQUIPMENT

24. General

- a. Inspect the trailer assembly for loose attachment bolts, cracked panel assemblies, bent brackets and other types of related damage. Inspect towing lunette and safety chain (Fig 66) for cracks, bends, or loose attaching bolts. Report any damage or deficiencies to the proper authority.

25. Springs and Shock Absorbers.

- a. Inspect spring assemblies for worn or cracked attaching bolts, broken shocks or broken or misplaced spring leaves.
- b. Inspect shock absorbers for broken mounting bolts and see that the mounting bolts are properly securing the mounting. Inspect for damage to the shock absorber bodies.

26. Air/Hydraulic

- a. Inspect the air/hydraulics brake system for worn or leaking air lines and hydraulic lines particularly at areas where they pass through frame members or around sharp corners.
- b. Inspect power cluster for proper hydraulic fluid level.
- c. Inspect the relay valve and air tank for evidence of leakage.
- d. Upon discovery of air leakage or fluid leakage, report to the proper authority.

27. Nose Box and Lights.

- a. Inspect the nose box for loose connections, both electrical and air. Report any defect or deficiency to the proper authority.
- b. Inspect the lights regularly for cracked lenses, loose mounting bolts, and spent bulbs. Replace all burned out bulbs immediately. Lights and their components are placed at specific areas on the equipment for identification and clearance; making it important to replace defective parts as soon as possible.

28. Wiring Harness.

- a. A cord connected to the electrical system of the towing vehicle is plugged into a standard receptacle on the trailer. Electrical current is supplied to tail lights, stop light and clearance lights. Inspect trailer wiring for loose connections, evidence of wear and breakage, and bare spots. Report any damage or malfunctioning to the proper authority. For ease in tracing , wires in the electrical system harness are number coded and tagged.

29. Reflectors.

- a. Replace broken reflectors as follows: Remove the two nuts, lockwashers, and bolts securing the reflector to the trailer chassis. Remove the reflector. Place a new reflector in position and secure with a bolt, lockwasher and nut at each side of the reflector.

30. Chocks, Chassis and Mud Guards.

- a. Ascertain that chocks are secured in their proper location either under wheels while equipment is in operation or in their cradles for towing the hot oil heater to a new jobsite.
- b. Inspect retaining chains for cracks or possible breakage. Inspect and replace extremely worn links.
- c. Inspect mud guards for possible tears, loose bolts or general deterioration. Report any deficiencies to the proper authority.

31. Tires and Wheels .

- a. Inspect tires for proper inflation, cuts, bruises, bulges and worn spots. Tire pressure should be 50 pounds per square inch.
- b. Inspect lug nuts to insure their proper tightness. Report any damage or malfunctioning to the proper authority.

**NOTE: IT IS IMPORTANT TO GIVE PROMPT ATTENTION TO THE
DISCOVERY OF ANY DAMAGE OR MALFUNCTIONING AS
DELAY WILL FURTHER AGGRAVATE EXISTING DAMAGE.**

CHAPTER III

OPERATOR AND ORGANIZATIONAL MAINTENANCE

INSTRUCTIONS

Section I. OPERATOR AND ORGANIZATIONAL MAINTENANCE TOOLS AND EQUIPMENT

32. Special Tools and Equipment

No special tools or equipment are required by the operator or organizational maintenance personnel for the maintenance of this hot oil heater. The caps on top of the hot oil strainers are provided with lugs to facilitate their removal using the three-way valve handle as a wrench.

33. Basic Issue Tools and Equipment.

Tools and repair parts issued with or authorized for the hot oil heater are listed in the basic issue items list, appendix II of this manual.

Section II. LUBRICATION

34. General Lubrication Information.

a. This section contains a reproduction of the lubrication order and lubrication instructions which are supplemental to, and not specifically covered, in the lubrication order.

b. The lubrication order shown in Fig. 15 is an exact reproduction of the approved lubrication order for the hot oil heater.

35. Detail Lubrication Information.

a. Care of Lubricants.

Keep all lubricants in closed containers and store in a clean, dry place away from external heat. Allow no dirt, dust, water, or other foreign material of any kind to mix with the lubricant.

b. Points of Lubrication.

Refer to Fig. 15 for illustration of the lubrication points.

c. Cleaning.

Keep all external parts not requiring lubrication clear of lubricant. Before lubricating the equipment, wipe all lubrication points free of dirt and grease. Clean all lubrication points after lubricating to prevent the accumulation of foreign matter.

FIGURE 15 LUBRICATION ORDER
HEATER, HOT OIL, TRLR. MTD.
2,100,000 BTU HOPKINS MODEL 200 STM

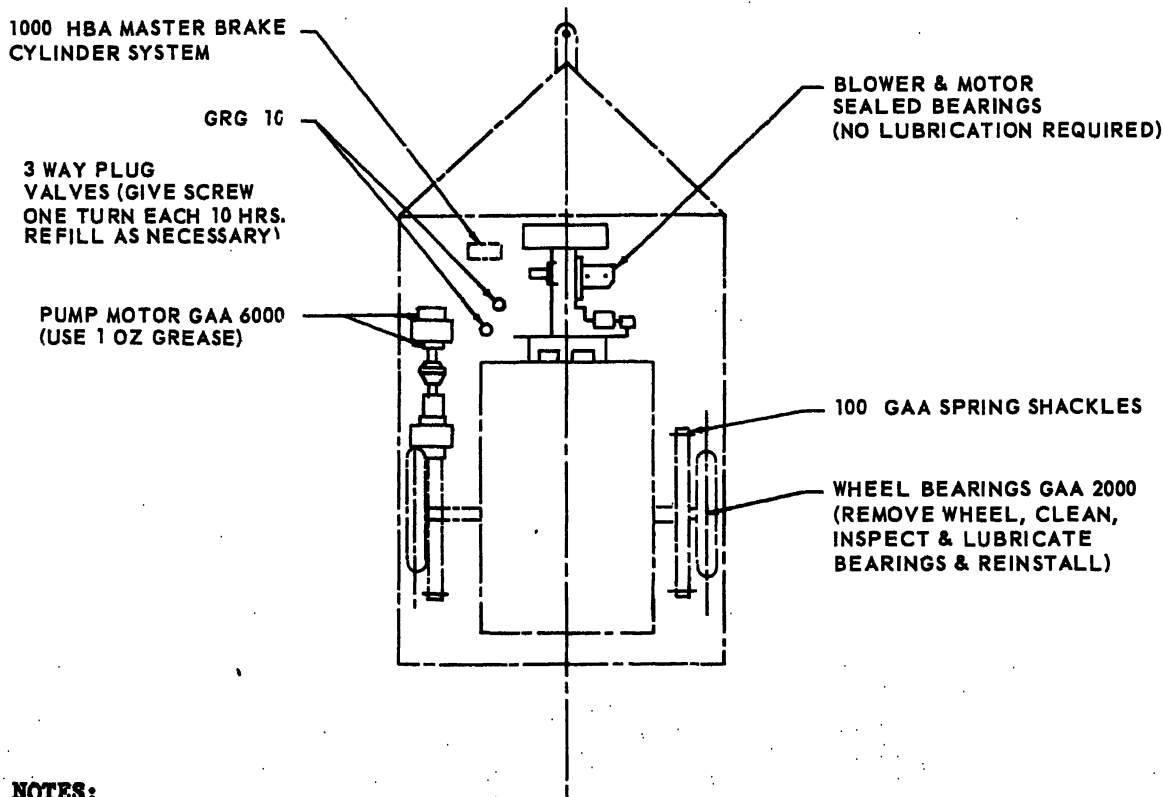
Intervals are based on normal hours of operation. Adjust to compensate for abnormal operation and severe conditions. During inactive periods, sufficient lubrications must be performed for adequate preservation.

Clean fittings before lubricating

Lubricate points indicated by dotted arrow shafts on both sides of equipment.

Clean parts with SOLVENT, dry-cleaning or with OIL, FUEL, DIESEL. Dry before lubricating.

LUBRICANTS	Capacity	Expected Temperatures			INTERVALS
		+32°F	+40°F to -10°F	0°F to -65°F	
OE-Oil, Eng. heavy duty		OE30	OE10	OE 10	Intervals given are in hours of normal operation.
GAA-Grease, Automotive & Artillery		A L L T E M P E R A T U R E S			
GRG-Grease plug valve					
FSN 9150-261-3290					
HBA-Brake fluid auto-motive brake cylinder	5/16 qt.				



NOTES:

- OIL CAN POINTS.** Every 50 hours lubricate control linkages, jack screws, and all exposed adjusting threads with OE.
- LUBRICANTS.** The following is a list of lubricants with the Military Symbols and applicable specification numbers.

OE MIL-L-2104
GRG MIL-G-6032

GAA MIL-G-10924
HBA MIL-H-13910

Section III. PREVENTIVE MAINTENANCE SERVICES

36. To insure that the hot oil heater is ready for operation at all times, it must be inspected systematically so that defects may be discovered and corrected before they result in more serious damage or failure. The necessary preventive maintenance services to be performed are listed and described in paragraphs 37 and 38. The item numbers indicate the sequence of minimum inspection requirements. Defects discovered during operation of the unit will be noted for further correction to be made as soon as possible. Stop operation immediately if a deficiency is noted during operation which would damage the equipment if operation were continued. Minor deficiencies may be cared for as soon as operation has ceased. All such deficiencies and shortcomings will be recorded, together with corrective action taken; on DA Form 2404 at the earliest possible opportunity.

37. Daily Preventive Maintenance Services.

This paragraph contains an illustrated, tabulated listing of preventive maintenance services which must be performed by the operator. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to Fig. 16 for the daily preventive maintenance services.

38. Quarterly Preventive Maintenance Services.

a. This paragraph contains an illustrated, tabulated listing of preventive maintenance services which must be performed by the organizational maintenance personnel at quarterly intervals. A quarterly interval is equal to three (3) calendar months, or 250 hours of operation, whichever occurs first.

b. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to Fig. 17 for the quarterly preventive maintenance services.

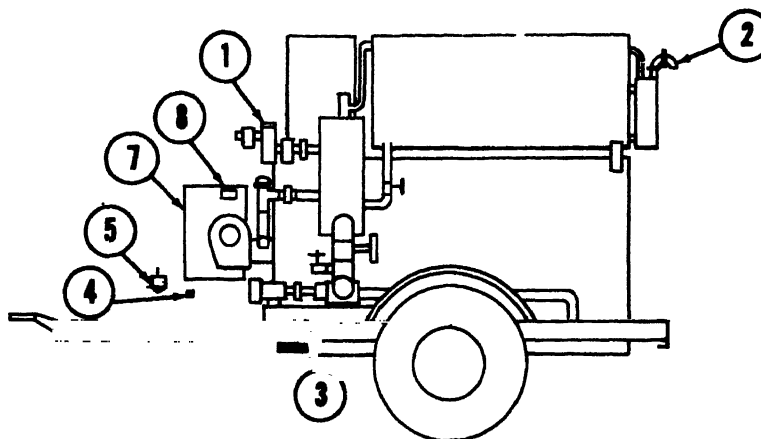


FIGURE 16. DAILY PREVENTIVE MAINTENANCE SERVICES

ITEM		PAR REF
1	HOT FLUID STRAINERS. Service the strainers. Drain water and sediment from strainers.	44
2	SURGE, COLD SEAL AND EXPANSION TANK. Add heat transfer oil as required. Drain as necessary.	
3	Pump DRIVE COUPLING. Tighten loose hardware.	94
4	GROUND TERMINAL AND GROUNDING ROD. Inspect for improper ground. Make sure all terminals and connections are tight, and that rod is a proper distance into the ground.	9
5	FUEL OIL STRAINERS AND FUEL OIL VALVES. Service the fuel oil strainers. Drain water and sediment from strainers. Inspect the valves for leaks and proper operation.	
6	FIRE EXTINGUISHER, <u>WHEN PROVIDED</u> . Inspect for broken seal and full charge.	
7	CONTROL BOX. Inspect for damage and loose connections. With unit operating, check for proper operation of the control box components.	
8	HEAT TRANSFER OIL CONTROLS AND INSTRUMENTS. Inspect for damage and loose connections. With unit operation, check for proper operation. Normal operation will present readings for instruments as follows:	15
	Liquid level sight gage	Nearly full
	Hot oil pressure gage	7 to 50 psi
	Hot oil temperature gage	100 ° to 450° F.
	Temperature controller	Limits set by operator
9	NOTE 1. OPERATION-DURING OPERATION OBSERVE FOR ANY UNUSUAL NOISE OR VIBRATION.	
10	NOTE 2. OPERATION-DURING OPERATION OBSERVE FOR LEAKS.	

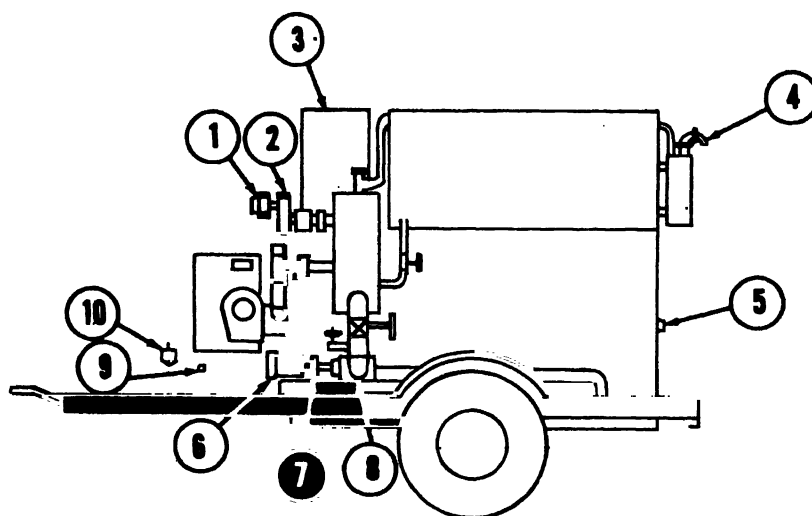


FIGURE 17. QUARTERLY PREVENTIVE MAINTENANCE SERVICES

ITEM		PAR REF.
1	THREE-WAY VALVES. Inspect for leaks. Replace a defective three-way valve.	97
2	HOT FLUID STRAINERS. Service the strainers, replace a defective strainer.	44 96
3	EXHAUST STACK. Tighten connections. Replace damaged rain cap and exhaust stack.	104
4	VENT PIPE ASSEMBLY. Clean vent and inspect for leaks. Replace a defective vent pipe assembly.	98
5	REAR PLATE VIEWER ASSEMBLY. Inspect for broken or obscured lenses and other damage. Replace a defective viewer assembly.	100
6	CIRCULATING PUMP MOTOR. Tighten loose connections, check alignment of motor with coupling. Test for operation. Replace a defective motor. Align the motor and pump drive coupling.	92 94
7	PUMP DRIVE COUPLING. Tighten loose connections. Replace a defective coupling.	94
8	CIRCULATING PUMP. Tighten packing nuts as required. Replace a defective pump.	94
9	GROUND TERMINAL AND GROUNDING ROD. Tighten loose connections. Replace defective parts.	9
10	FUEL OIL STRAINERS. Replace strainer filter elements. Replace a defective strainer.	107

11	CONTROLS AND INSTRUMENTS. Replace defective instrument. Tighten loose mounting.	80-110 111-112
12	FUEL OIL PUMP. Inspect for leaks and operation. Adjust for pump pressure (160 PSI) if necessary. Replace defective pump.	45-106
13	PROGRAM CONTROLLER AND BLOWER MOTOR START. Inspect for damage and loose mounting. With unit operating check for proper operation. Replace defective blower motor starter or program controller.	77-79
14	BLOWER MOTOR AND BLOWER. Tighten loose connections test motor for operation. Replace defective parts.	91-101
15	NOZZLE AND ELECTRODE ASSEMBLY. Clean and inspect for oil leaks. Inspect electrodes for damage and correct adjustment. Repair oil leaks and replace defective parts.	103-108

Section IV. OPERATOR'S MAINTENANCE

39. General

In addition to the services described in paragraph 37, the operator will perform the following maintenance on the hot oil heater.

40. Fuses

- a. Removal. Refer to Fig. 18 and remove the fuses.

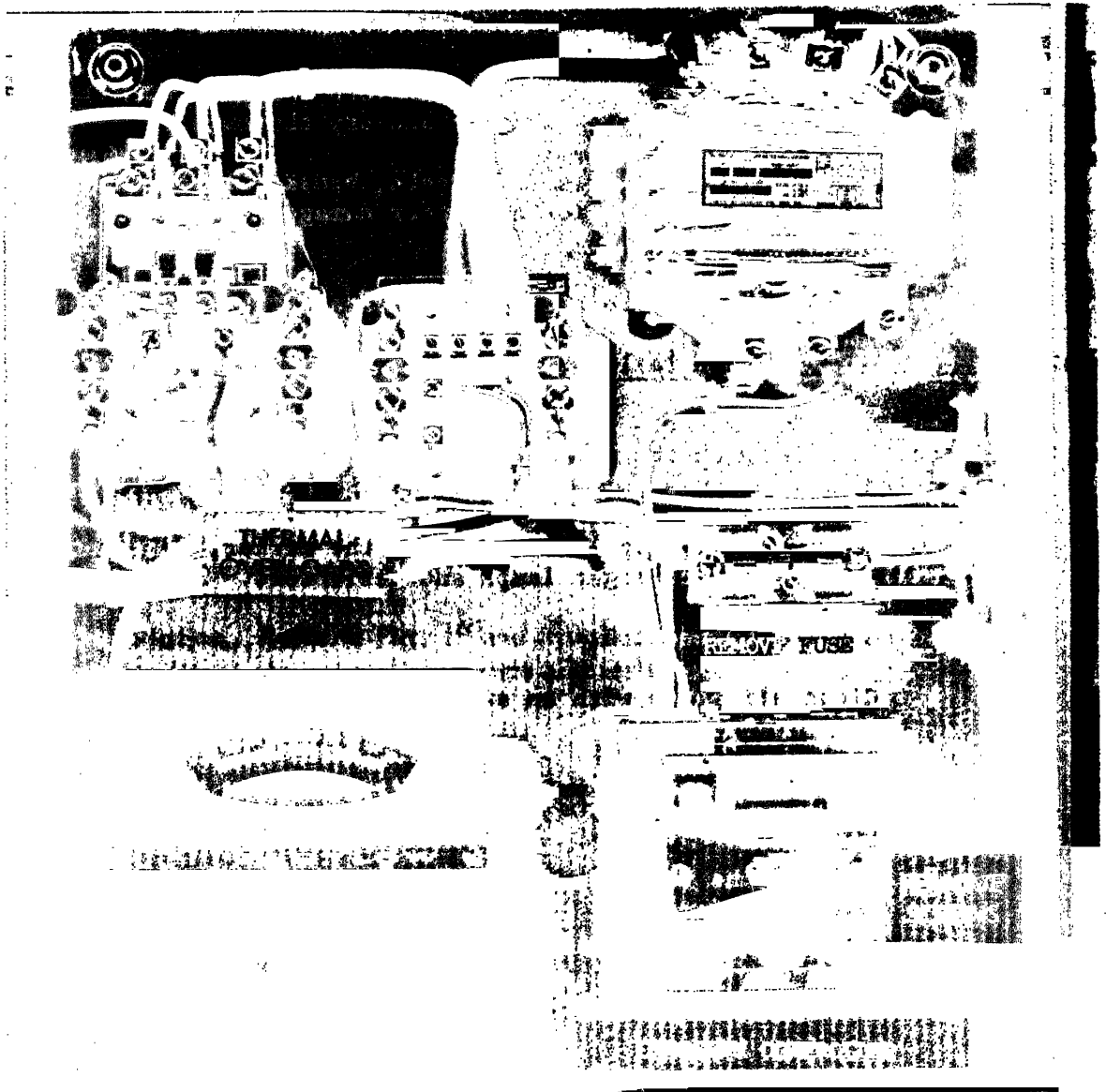


FIGURE 18. SERVICE TO PROGRAM CONTROL AND FUSES

b. Cleaning and Inspection.

1. Clean the fuses with a cloth dampened with an approved cleaning solvent and dry thoroughly.
2. Inspect the fuses for corrosion or other damage. Replace a defective fuse.

c. Installation. Refer to Fig. 18 and install the fuses.

41. Program Controller

a. Removal. Refer to Fig. 18 and remove the program controller.

b. Cleaning and Inspection.

1. Clean terminals on back with a cloth dampened with an approved cleaning solvent and dry thoroughly.
2. Inspect the terminals for cracks, breaks, loose connections in the base, corrosion and other damage. Replace a defective control or base.

c. Installation. Refer to Fig. 18 and install the program controller.

42. Marker Blackout, and Taillight Clearance Light Lamps and Reflectors.

a. General. The marker, blackout, and taillight, including the lamps are the same with the different color and type of lenses. All parts, including the lamps, with the exception of the lens are the same.

b. Removal. Refer to Fig. 19 and remove the marker, blackout, and taillight clearance light lamps and reflectors.

c. Cleaning and Inspection.

1. Clean all parts with an approved cleaning solvent and dry thoroughly.
2. Inspect the reflectors for condition of the reflecting surface and other damage.
3. Inspect the reflectors for condition of the reflecting surface and other damage.

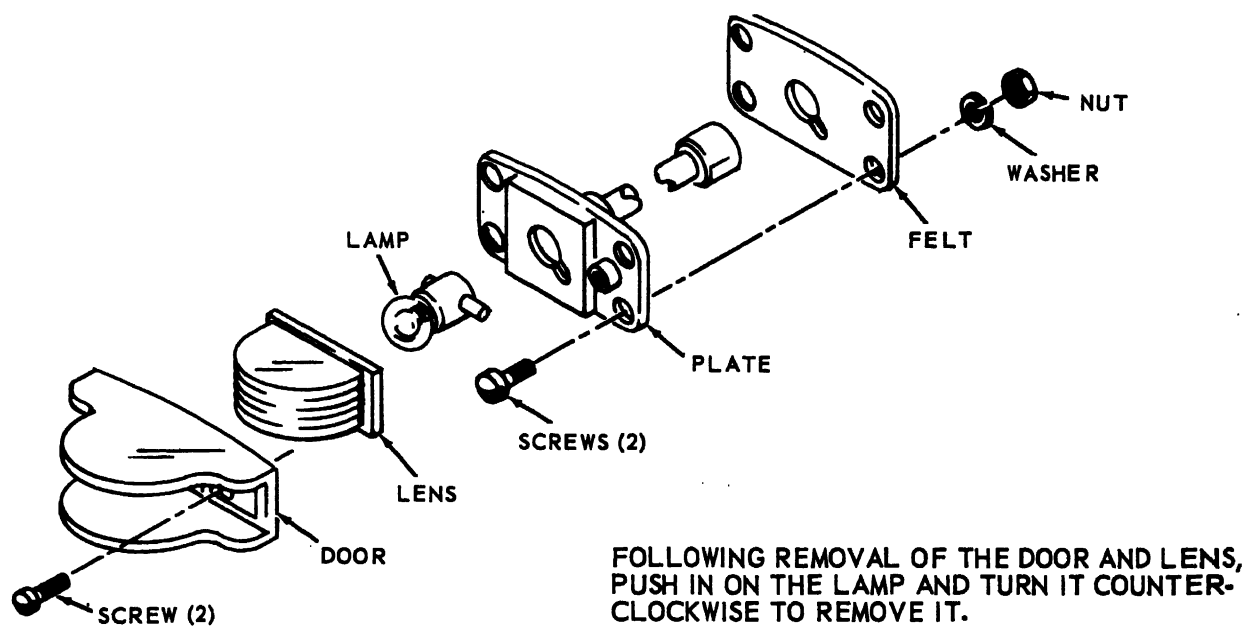


FIGURE 19. SERVICE TO MARKER AND CLEARANCE LAMPS

4. Inspect the mounting hardware for cracks, breaks and damaged threads.

5. Replace a defective part.

d. Installation. Refer to Fig. 19 and install the marker, blackout and taillight clearance light lamps and reflectors.

43. Fuel Oil Strainer Service Requirements

Refer to Fig. 20 and service the fuel oil strainers.

44. Hot Fluid Strainer Service Requirements

Refer to Fig. 21 and service the hot fluid strainers

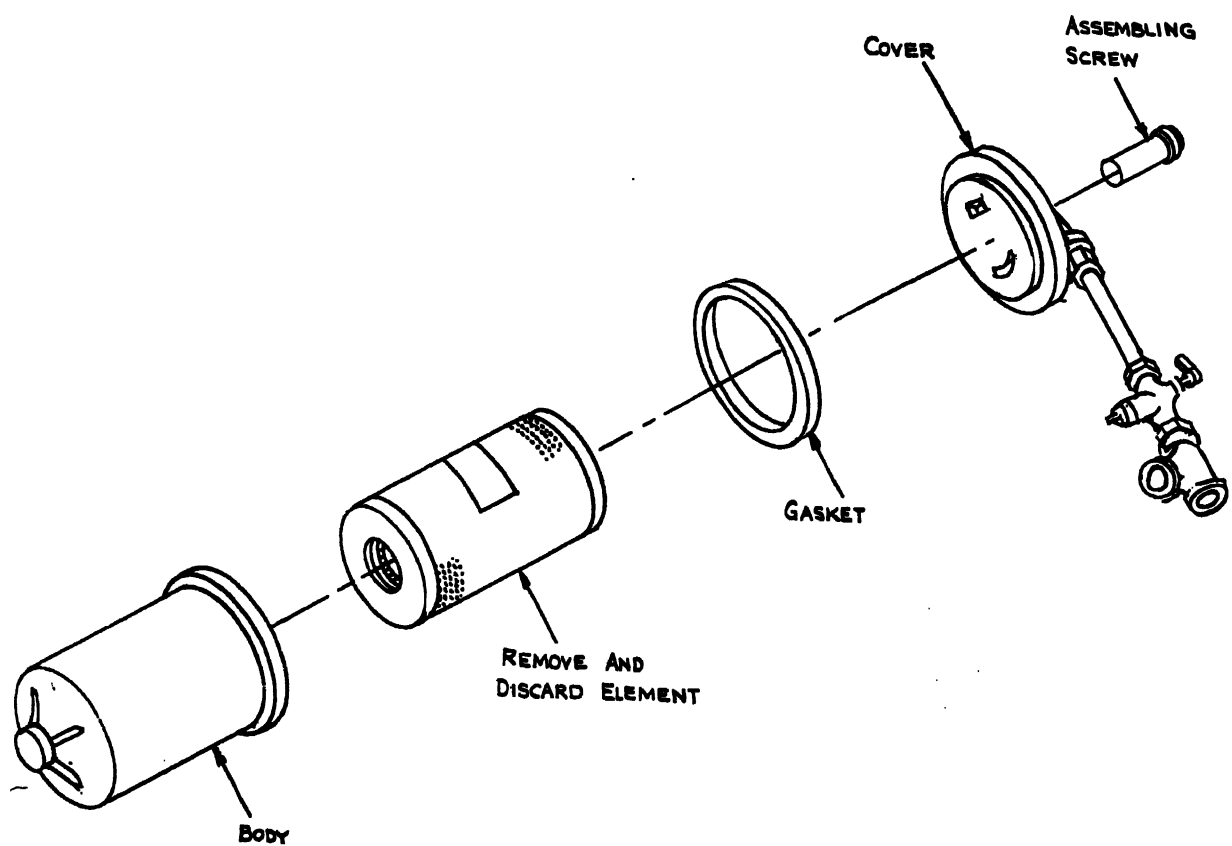


FIGURE 20. SERVICE FUEL OIL STRAINERS

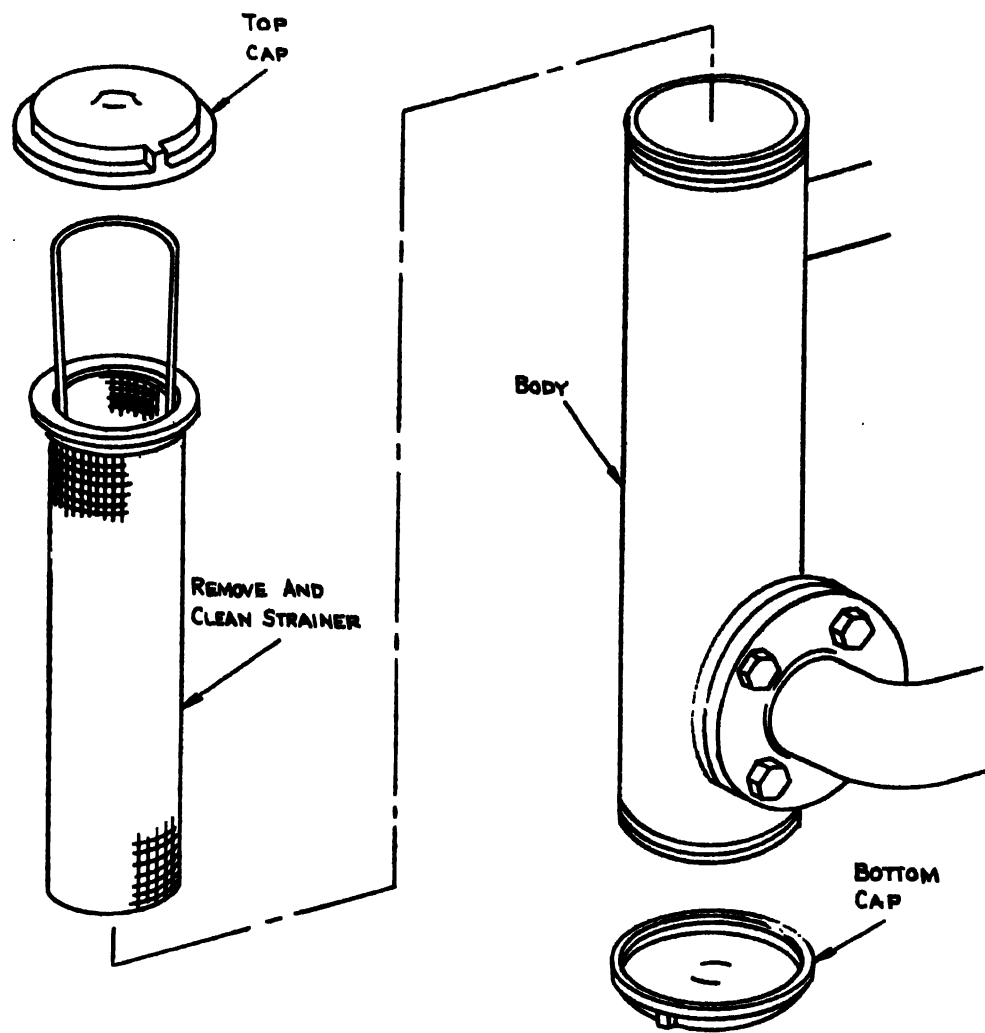


FIGURE 21. SERVICE TO HOT FLUID STRAINERS

45. Fuel Pump Adjustment

Refer to Fig. 22 and adjust the fuel pump.

WARNING: THIS IS A TWO STAGE PUMP AND MUST HAVE A RETURN LINE BACK TO FUEL SUPPLY TANK.

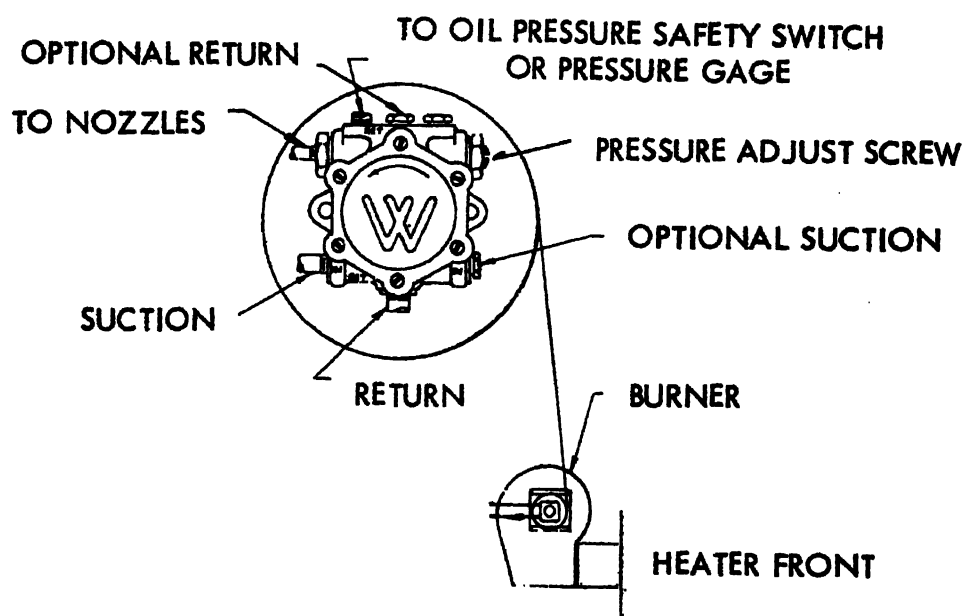


FIGURE 22. FUEL OIL PUMP ADJUSTMENTS

- Step 1. Remove the adjusting screw cover to expose the pressure adjusting Screw.
- Step 2. Remove the test gage port plug.
- Step 3. Install a test gage with a range of 0 to 300 PSI in the test gage port.
- Step 4. Start the hot oil heater (Para. 17).
- Step 5. Using the pressure adjusting screw set pressure to 160 PSI.
- Step 6. Stop the hot oil heater (Para. 17).
- Step 7. Remove the test gage and install the test gage port plug and the adjusting screw cover.

Section V. TROUBLESHOOTING

46. General

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the hot oil heater and its components. Each trouble symptom stated is followed by a list of probable causes of the trouble. The possible remedy recommended is stated and described opposite the probable cause. Any trouble beyond the scope of organizational maintenance will be reported to direct support maintenance.

47. TRANSFER OIL DOES NOT CIRCULATE PROPERLY

<u>Probable Cause</u>	<u>Possible Remedy</u>
Supply Valve closed or partially closed	Open the supply valve (Para 17)
Pump rotation incorrect	Reverse the rotation of the circulating pump (Para 94)
Three-way valve closed or partially closed	Open the three-way valve (Para 17)
Circulating pump motor-to-pump drive coupling broken	Replace a defective coupling (Para 94)
Pump not primed	Prime the pump with transfer oil (Para 94)
Air or water vapor trapped in lines	Make certain that vent plug is open. Open top of sight glass. Be careful not to get burned.
Hot fluid strainers clogged	Service the hot fluid strainers (Para 44)

48. CIRCULATING PUMP NOISY

<u>Probable Cause</u>	<u>Possible Remedy</u>
Circulating pump and circulating pump motor out of alignment.	Align the pump and motor (Paras. 92 94)
Circulating pump defective	Replace a defective circulating pump. (Para 94)
Pump is cavitating	Check all information in Para 47.

49. CIRCULATING PUMP DEFECTIVE

<u>Probable Cause</u>	<u>Possible Remedy</u>
Dirt or grit in transfer oil.	Service the hot fluid strainers. Drain all hot fluid and refill surge and reservoir and expansion tank. Replace defective circulating pump and motor. (Para 94)

50. CIRCULATING PUMP CAPACITY IS LOW

<u>Probable Cause</u>	<u>Possible Remedy</u>
Circulating pump motor does not deliver rated rpms.	Replace a defective motor (Para 92)
Air leaks or cavitation	Tighten all loose or leaking pipe or hose fittings in the hot fluid transfer oil system. (Paras 10 & 97)
Packing causing friction	Adjust packing nuts (Para 94)
Circulating pump defective	Replace a defective pump (Para 94)

51. CIRCULATING PUMP MOTOR WILL NOT START

<u>Probable Cause</u>	<u>Possible Remedy</u>
Circuit breaker has tripped because of overload	Allow sufficient time for cooling, reset at circulating pump motor starter and blower motor starter. Start hot oil heater. (Para 17)
Power not connected	Inspect external power source. Check continuity of power lines (Paras 10, 71)
Voltage too low	Test rating of incoming external power (Para 4) and remedy cause of low voltage
Improper power connections	Make the correct connections (Paras 10, 92)

Circulating pump is locked

Replace a defective pump (Para 94)

52. BLOWER MOTOR STARTER CIRCUIT BREAKER CONTINUES TO TRIP

Probable Cause

Possible Remedy

Blower motor pulling too much amperage

Check amperage at starter

Blower motor starter circuit breaker defective

Replace a defective blower motor starter (Para 77)

Ambient temperature is above 125° F

Open control box for ventilation. Shade control box from direct sunlight

53. BLOWER MOTOR WILL NOT START

Probable Cause

Possible Remedy

Circuit breaker has tripped because of overload

Allow sufficient time for cooling, reset blower motor starter in control box (Para 17)

Power not connected

Inspect external power source. Check continuity of power lines (Paras 10, 71)

Starter "chatters"

Check reduced voltage transformer for 110/1/60 supply. Replace faulty transformer

Operating limit open

Check oil level at sight glass rear of expansion tank, oil pressure setting on pressuretrol, hot oil temperature controller setting, overload in blower starter may be tripped

Probable Cause

Possible Remedy

Voltage too low

Test rating of incoming external power. (Para 4) and remedy cause.

Improper power connections

Make the correct connections (Para 77)

Fuel Pump or blower fan locked

Replace a defective fuel pump or blower fan (Paras. 91, 101 and 106)

Program Control on safety
lockout

Reset program control

54. CIRCULATING PUMP MOTOR NOISY

Probable Cause

Possible Remedy

Circulating pump motor running
single phase

Inspect for open circuit and make
necessary repairs (Paras. 71, 92)

Circulating pump motor out of
alignment with the pump

Inspect condition of the drive
coupling. Align the pump and
motor (Paras. 92, 94)

Defective circulating pump

Operate the motor without a load.
Replace a defective pump or motor
if necessary (Paras. 92, 94)

Mounting bolts loose

Tighten mounting bolts

Bearings worn out

Replace Bearings

55. CIRCULATING PUMP MOTOR RUNS HOT

Probable Cause

Possible Remedy

Circulating pump motor running
single phase

Inspect for open circuit and make
necessary repairs (Paras. 71, 92)

Improperly adjusted pump packing,
defective pump

Adjust the packing nuts or replace
a defective pump (Para 94)

Incorrect voltage and frequency

Inspect incoming external power
source (Paras. 4, 10)

Restricted ventilation

Clean air passages (Para 92)

Coupling out of alignment

Align the circulating pump motor
and the circulating pump (Paras. 92,
94)

56. HOT OIL HEATER WILL NOT START

Probable Cause

Circulating pump motor starter and blower motor starter circuit breakers open

Fuse blown

Low oil condition

Possible Remedv

Reset motor starters (Para 17)

Replace one or both fuses as necessary (Para 40)

Fill with circulating oil as necessary

57. BURNER FAILS TO IGNITE

Probable Cause

Ignition transformer defective

Coupling between fuel pump and blower loose or broken

Burner electrodes improperly gapped

Carbon deposits on electrode tips

Pressuretrol out of adjustment or defective

U.V. Cell inoperative

No fuel going to burner nozzles

Possible Remedv

Replace a defective ignition transformer (Para 85)

Replace a defective coupling (Paras. 91, 101 and 106)

Adjust the burner electrodes (Para 103)

Clean off carbon deposits and adjust the electrode (Para 103)

Adjust pressuretrol or replace a defective pressuretrol (Para 83)

Replace a defective electron tube or replace a defective U.V. Cell (Para 86)

Check fuel strainers and check for plugged fuel line

58. BURNER FLAME FAILURE

Probable Cause

Defective burner oil solenoid

Fuel lines leaking air

Possible Remedv

Replace a defective burner oil solenoid (Para 90)

Tighten all fittings and replace a leaking oil line (Para 108)

58. BURNER FLAME FAILURE (Cont)

<u>Probable Cause</u>	<u>Possible Remedy</u>
Low fuel oil pressure	Adjust the fuel pump (Para 45)
Coupling between fuel pump and blower motor, loose or broken	Replace a defective coupling (Paras. 91, 101, and 106)
Fuel oil strainers clogged	Service or replace a defective fuel oil strainer (Paras. 43, 107)
Fuel valve closed or partially closed	Open the fuel valves (Para 17)
U.V. Cell inoperative	Replace a defective electron tube or a defective U.V. Cell (Para 80)

59. FUEL PUMP FAILS TO DELIVER ADEQUATE PRESSURE

<u>Probable Cause</u>	<u>Possible Remedy</u>
Fuel pump improperly adjusted	Adjust the fuel pump pressure (Para 45)
Air leak in intake line	Tighten fittings in intake line or replace a defective line (Para 108)
Restricted intake line	Inspect tubing and valves for restrictions and damage. Replace a defective line or valve (Para 108)
Slipping or broken coupling to blower motor	Replace a defective coupling (Para 94)
Improper pump rotation	Reverse the direction of the rotation of the pump (Para 91)
Frozen pump shaft	Replace a defective fuel pump (Para 106)

60. FUEL PUMP NOISY

Probable Cause

Improper coupling alignment

Gear click on newly installed pump

Possible Remedy

Reline fuel pump to coupling (Paras. 91, 101, and 106)

Continue operation for 4 to 5 hours to eliminate noise. Replace a defective fuel pump. (Para 106)

61. PULSATING FUEL PUMP PRESSURE

Probable Cause

Fuel oil strainers clogged

Intake line or fuel valves leaking

Fuel oil strainer cover leaks

Possible Remedy

Service the fuel oil strainers (Para 43)

Tighten all fittings. Replace a defective line or fuel valve (Para 108)

Tighten cover screws (Para 107)

62. BURNER EXHAUST SMOKY

Probable Cause

Damper cylinder linkage out of adjustment

Air damper improperly positioned

Air damper cylinder defective

Possible Remedy

Adjust damper linkage (Para 88)

Position properly

Replace a defective damper cylinder (Para 88)

63. BLOWER MECHANISM WILL NOT PROGRAM OUT OF PREPURGE

Probable Cause

Program controller defective

Possible Remedy

Replace a defective program controller (Para 79)

64. BURNER MECHANISM WILL NOT PROGRAM OUT OF LOW-FIRE

<u>Probable Cause</u>	<u>Possible Remedy</u>
Program Controller defective	Replace a defective program controller (Para 79)
Voltage low	Inspect incoming external power for proper rating (Para 4)
High fire solenoid valve defective	Replace defective solenoid valve
Defective oil cylinder	Replace defective oil cylinder (Para 88)

65. U.V. CELL FAILS TO OPERATE

<u>Probable Cause</u>	<u>Possible Remedy</u>
Viewing window on U.V. Cell tube obscured	Clean viewing window (Para 86)
Defective electron tube	Replace a defective electron tube (Para 86)
Program controller defective	Replace a defective program controller (Para 79)

66. PROGRAM CONTROLLER WILL NOT START OPERATING SEQUENCE

<u>Probable Cause</u>	<u>Possible Remedy</u>
Blower motor starter reset switch open	Reset switch (Para 17)
Defective blower motor starter	Replace a defective blower motor starter (Para 77)
Operating limit open	Check oil level in expansion tank for low level, oil pressure and pressuretrol setting, hot oil temperature and temperature controller settings, overloads in starters.

66 PROGRAM CONTROLLER WILL NOT START OPERATING SEQUENCE (Cont)

<u>Probable Cause</u>	<u>Possible Remedy</u>
Temperature controller improperly set or defective	Set operating limits on temperature controller compatible with heat range of hot oil heater. Replace a defective temperature controller (Paras 18, 80)
Program controller defective	Replace a defective program controller (Para 79)
Burner switch turned to "OFF" position	Turn switch to "ON" position
Control power dead	Check transformer for out put and check fuses

Section VI. RADIO INTERFERENCE SUPPRESSION

67. General Methods Used to Attain Proper Suppression.

Essentially, suppression is attained by providing a low-resistance path to ground for the stray currents. The methods used include shielding the ignition and high-frequency wires, grounding the frame with bonding straps and using capacitors and resistors. For general information on radio interference suppression, see TM-11-483.

68. Interference Suppression Components.

a. **Wiring.** The external hot oil heater wiring not found in electrical wiring conduits is shielded for radio suppression. For information regarding location, routing, and correct hookup of the wiring, refer to Fig. 5.

b. **Grounding Rod.** General radio suppression for the units and components mounted on the trailer frame is attained by using the grounding rod. It is one of the first items installed when the equipment arrives at its worksite and one of the last to be removed and stored for movement to a new worksite.

c. **Lockwashers.** The hot oil heater is bonded in numerous places with lockwashers to insure a good metal-to-metal contact to provide proper shielding and grounding of components.

69. Replacement of Suppression Components.

a. **Wiring.** Refer to paragraph 71 for instructions in the removal and installation of the wiring.

b. **Grounding Rod.**

1. **Removal.** Remove the grounding rod (Fig. 8) from its installed position.

2. **Installation.** Refer to Fig. 8 for instructions for installing the grounding rod.

c. **Lockwashers.** Refer to the maintenance sections of this manual (Paras. 70 through 118 and 146 through 204) for removal and installation of the lockwashers.

NOTE: DO NOT REMOVE MOUNTING SCREWS SECURING THE LOCKWASHERS MERELY FOR THE PURPOSE OF RADIO SUPPRESSION, BUT ONLY IF THE ITEM IS SUSPECT OF CAUSING RADIO INTERFERENCE, OR UPON EXAMINATION AT THE TIME OF REQUIRED REMOVAL THEY ARE IN NEED OF REPLACEMENT.

Section VII, ELECTRICAL SYSTEMS

70. General

The electrical complex of the hot oil heater consists of two separate electrical systems. The clearance, blackout, stop, and taillights normally are operated only when the unit is joined to a tractor or other hauling vehicle for traveling and operate from the towing vehicle's electrical generating system. The hot oil heater electrical components are energized by an external power source of much higher electrical rating. Lights require a 24 volt power supply, whereas heater requirements are: 30/60 cycle/220 volts.

WARNING: DO NOT PERFORM MAINTENANCE OR SERVICE TO THE HOT OIL HEATER'S ELECTRICAL SYSTEM UNTIL THE EXTERNAL ELECTRICAL POWER SERVICE CABLE HAS BEEN DISCONNECTED.

71. Wiring and Conduits.

a. **General.** Inspect the wiring for defective insulation. Pay particular attention to locations where wires pass over metal edges. Wrap slight insulation deterioration with an approved electrical tape. Refer to the clearance light and trailer wiring diagram and the wiring schematic for the hot oil heater (Figs. 4 and 5) when repairing or replacing wires. Tag each wire and corresponding terminal before removal to insure correct reassembly of the wire to the proper terminal.

b. **Testing.** To test wires for continuity, disconnect each end of the wire from the component to which it is attached. Touch probes of a test instrument to each end of the wire disconnected. If the test does not indicate continuity, replace the wire. Test for improper ground by placing a test probe to one end of the wire and the other probe to the frame of the hot oil heater. If the test instrument indicates a ground where no ground should be indicated, repair or replace the wire.

c. **Removal.** Refer to Fig. 23 and remove the wiring and conduits.

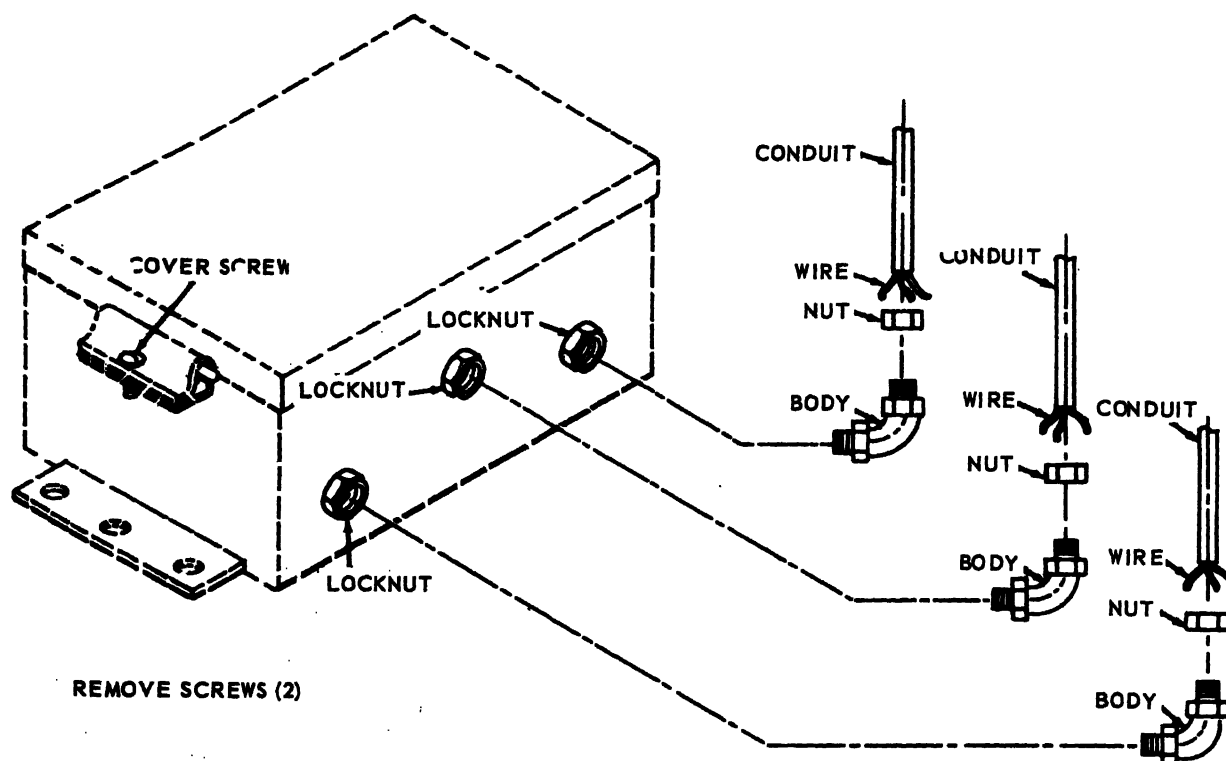
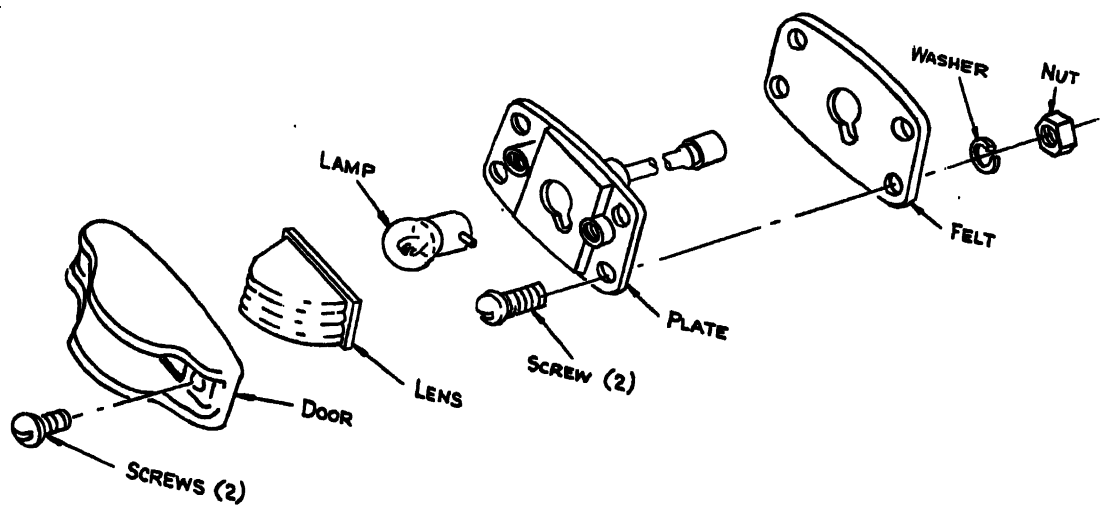


FIGURE 23. CONDUIT BOX ASSEMBLED AND DISASSEMBLED

- Step 1.** Remove or loosen cover screws as necessary and remove a junction box cover.
- Step 2.** Tag and disconnect wiring. Wiring may be secured at a junction block or at taped connections.
- Step 3.** Loosen any conduit nut and separate from the conduit.
- Step 4.** Loosen the locknut and remove the conduit from the junction box.
- Step 5.** Remove the mounting screws inside the junction box and remove the junction box from the burner plate.
- Step 6.** Remove the external power source service cable (Para. 10).
- Step 7.** Remove the mounting cap screws on the exterior of the junction box and remove the box from the heater hull.
- Step 8.** Remove the remaining junction box, also mounted to the burner plate, in a similar manner.



FOLLOWING REMOVAL OF THE DOOR AND LENS,
PUSH IN ON THE LAMP AND TURN IT COUNTER-
CLOCKWISE TO REMOVE IT.

**FIGURE 24. REMOVAL AND SERVICE MARKER, BLACKOUT AND
CLEARANCE LIGHTS**

d. Cleaning, Inspection, and Repair

1. Clean all parts with an approved cleaning solvent and dry thoroughly.
2. Inspect for signs of wear and other damage. Replace a defective part.

e. Installation. Refer to Fig. 23 and install the wiring and conduits.

72. Junction Boxes.

a. Removal. Refer to Fig. 23 and remove the junction boxes.

b. Cleaning and Inspection.

1. Clean all parts with an approved cleaning solvent and dry thoroughly.
2. Inspect the box for cracks, breaks, or warpage and other damage.
3. Inspect the mounting hardware for cracks, breaks, and damaged threads. Replace all defective parts.

c. Installation. Refer to Fig. 23 and install the junction boxes.

73. Marker, Blackout and Taillight Clearance Lights.

a. Removal and Disassembly. Refer to Fig. 24 and remove and disassemble the marker, blackout and taillight clearance lights.

NOTE: THE MARKER, BLACKOUT, AND TAILLIGHT CLEARANCE LIGHTS ARE IDENTICAL EXCEPT FOR THE COLOR OF THE LENS AND ARE REMOVED AND INSTALLED IN A SIMILAR MANNER.

b. Cleaning and Inspection.

1. Clean all parts with an approved cleaning solvent and dry thoroughly.
2. Inspect for cracked or broken lenses and other damage.
3. Inspect the mounting hardware for cracks, breaks and damaged threads.
4. Replace a missing or damaged part, taking care to replace with proper color and type of lens.

c. Reassembly and Installation. Refer to Fig. 24(above) and reassemble and install the marker, blackout, and taillight clearance lights.

74. Program Control Cover

- a. Removal. Refer to Fig. 25 and remove the program control cover.

NOTE: WITH COVER REMOVED IT IS POSSIBLE TO CHECK CONTROL CHASSIS FOR DIRT AND MOISTURE ACCUMULATION.

- b. Cleaning and Inspection.

1. Clean the control of dirt or other foreign material with a soft, dry cloth or soft bristle brush.
2. Inspect for broken or loose wires and signs of overheating.
3. Inspect for any signs of undue moisture accumulation or corrosion.

- c. Installation. Refer to Fig. 25 and install cover.

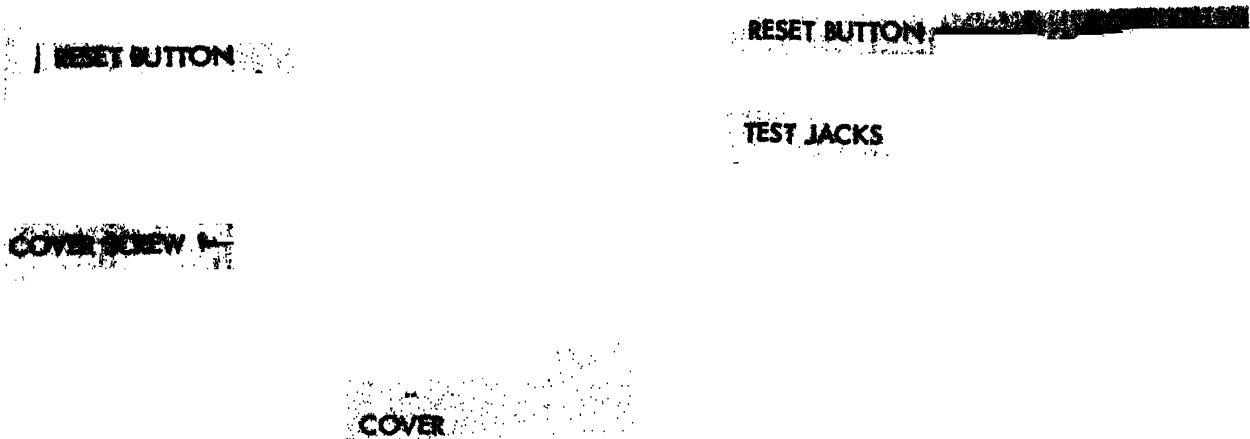


FIGURE 25. REMOVAL AND SERVICE OF PROGRAM CONTROL



FIGURE 25A. REMOVAL AND SERVICE OF CONTROL EQUIPMENT

75. Fuse Block

a. Removal

1. Remove the fuses. (Para. 40).
2. Refer to Fig. 25 and remove the fuse block.

b. Cleaning and Inspection.

1. Clean all parts with a cloth dampened in an approved cleaning solvent and dry thoroughly.
2. Inspect for cracks, breaks, and other damage.
3. Inspect the mounting hardware for cracks, breaks, and damaged threads.
4. Replace a defective fuse block.

c. Installation.

1. Refer to Fig. 25 and install the fuse block.
2. Install the fuses (Para. 40).

76. Blower Motor Starter Heaters.

a. Removal. Refer to Fig. 25 and remove the blower motor starter heaters.

b. Cleaning and Inspection.

1. Clean all parts with a cloth dampened in an approved cleaning solvent and dry thoroughly.
2. Inspect the heaters for cracks, breaks, signs of overheating, and other damage.
3. Inspect the mounting hardware for cracks, breaks, and damaged threads.
4. Replace a defective part.

c. Installation. Refer to Fig. 25 and install the blower motor starter heaters.

77. Blower Motor Starter.

a. Removal.

1. Remove the blower motor starter heaters. (Para. 76)
2. Refer to Fig. 25 and remove the blower motor starter.

b. Cleaning and Inspection.

1. Clean all parts with a cloth dampened in an approved cleaning solvent and dry thoroughly.
2. Inspect the blower motor starter for corrosion, damaged terminal posts, signs of overheating, and other damage.

3. Inspect the mounting hardware for cracks, breaks, and damaged threads.
4. Replace defective parts.
5. DO NOT FILE CONTACTS.

c. Installation.

1. Refer to Fig. 25 and install the blower motor starter.
2. Install the blower motor starter heaters. (Para. 76).

79. Program Controller.

a. Removal.

1. Remove the cover.
2. Refer to Fig 25 and remove the program controller.

b. Cleaning and Inspection.

1. Clean the program controller with an approved cleaning solvent and dry thoroughly.
2. Inspect for corrosion, missing terminal screws, signs of overheating and other damage.
3. Replace a missing terminal screw. Replace a defective program controller.

c. Installation.

1. Refer to Fig. 25 and install the program controller.
2. Install the cover. (Para. 74)

80. Temperature Controller

a. On-Equipment Testing.

1. Refer to Fig. 26 and remove the hot oil temperature controller and replace with a reliable testing thermometer.
2. Start the hot oil heater. (Para. 17).

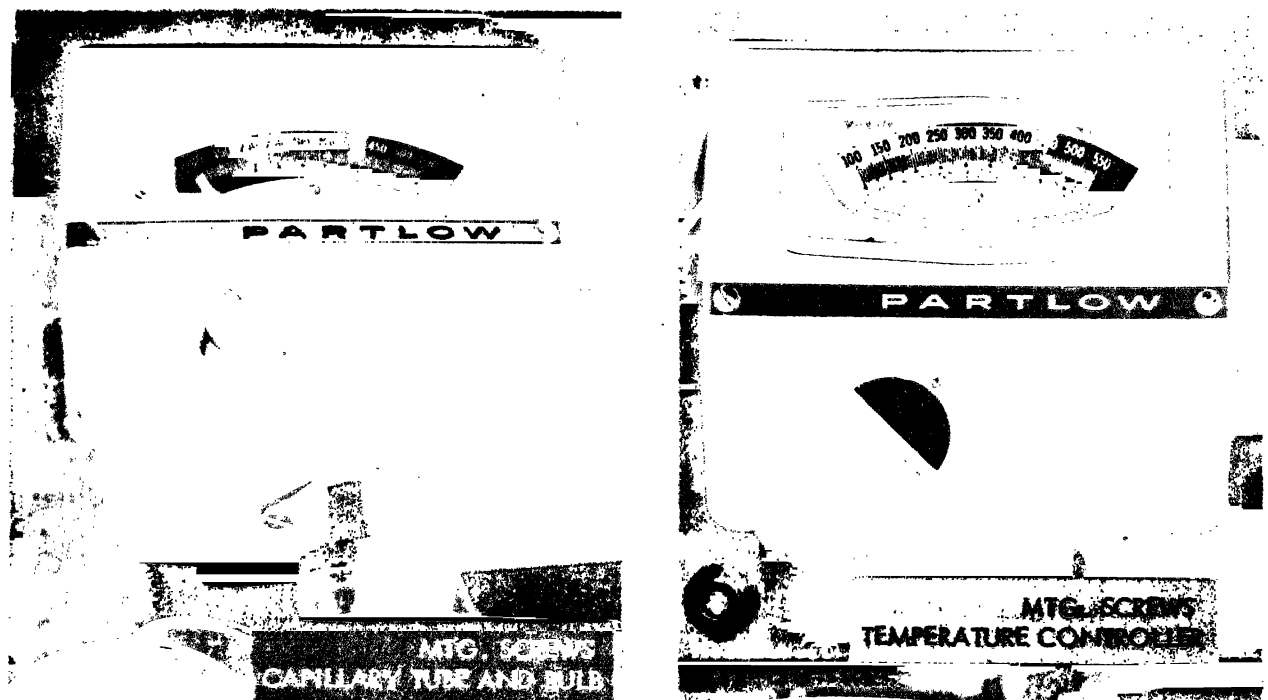


FIGURE 26. REMOVAL AND SERVICE OF TEMPERATURE CONTROL

3. The temperature control should be set to within plus or minus of 15° of that shown on the test thermometer.
 4. If the temperature control does not respond as above, replace the capillary tube and bulb.
 5. Following replacement of the capillary tube and bulb, perform steps one (1) through three (3) above. If the temperature controller does not respond as indicated in three (3) above, the controller is defective and should be replaced.
 6. It is possible to calibrate the control (Fig. 26) using the small wrench provided. This calibration should not be made unless the capillary tube and bulb has first been checked as outlined in one (1) through three (3) above.
 7. Following the test, stop the hot oil heater. (Para. 17).
 8. Remove the test thermometer and reinstall the regular thermometer in the line.
- b. Removal. Refer to Fig. 26 and remove the temperature controller.

81. Circulating Pump Motor Starter Heaters

a. Removal. Refer to Fig. 27 and remove the circulating pump motor starter heaters.

b. Cleaning and Inspection.

1. Clean all parts with a cloth dampened in an approved cleaning solvent and dry thoroughly.

2. Inspect the heaters for cracks, breaks, signs of overheating and other damage.

3. Inspect the mounting hardware for cracks, breaks, signs of overheating, breaks, and damaged threads.

4. Replace any defective parts.

c. Installation. Refer to Fig. 27 and install the circulating pump motor starter heaters.

82. Circulating Pump Motor Starter.

a. Removal.

1. Remove the circulating pump motor starter heaters.

2. Refer to Fig. 27 and remove the circulating pump motor starter.

b. Cleaning and Inspection.

1. Clean all parts with a cloth dampened in an approved cleaning solvent and dry thoroughly.

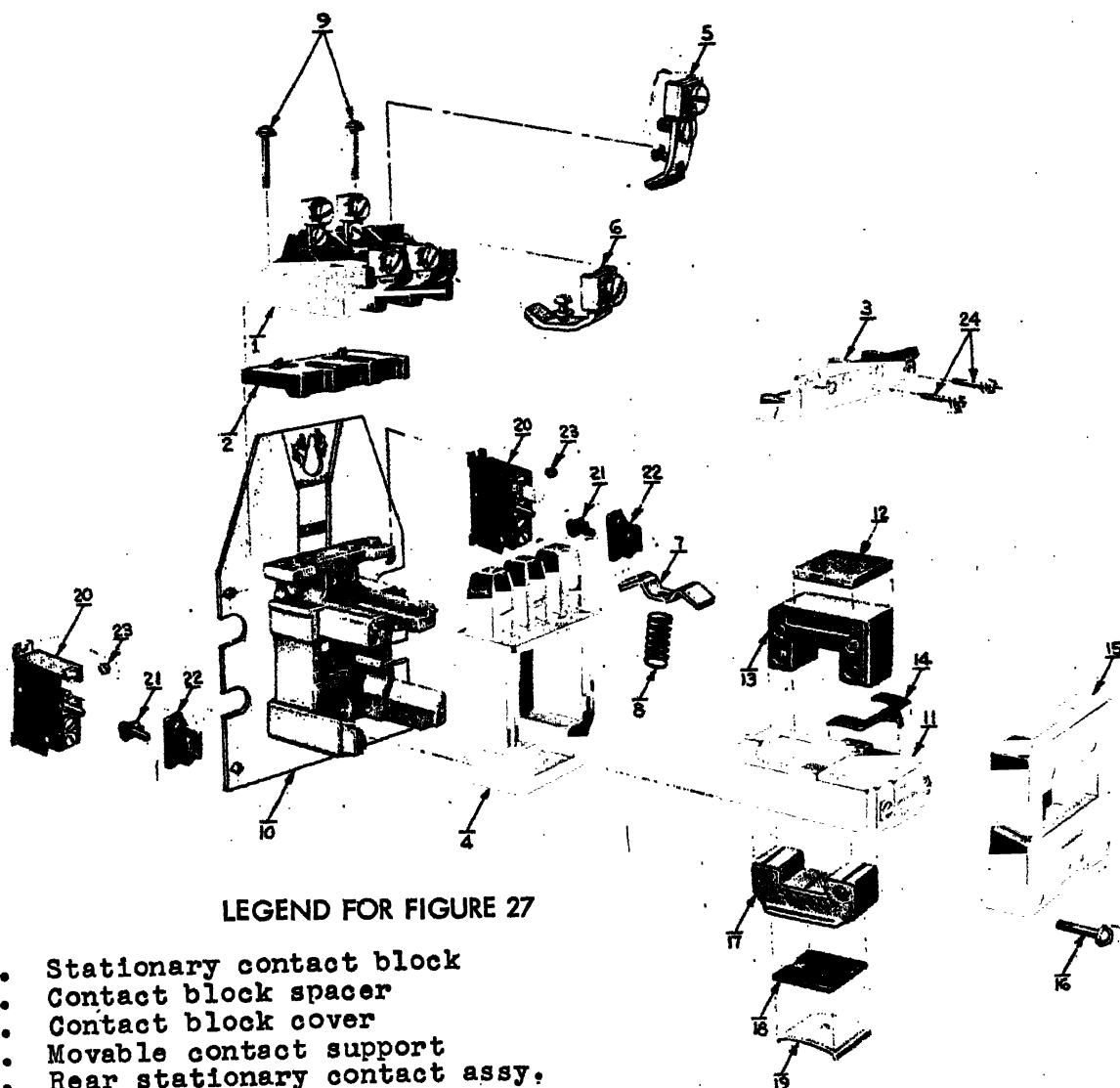
2. Inspect the circulating pump motor starter for corrosion, damaged terminal posts, overheating, and other damage.

3. Inspect the mounting hardware for cracks, breaks, and damaged threads. Replace all defective parts.

c. Installation.

1. Refer to Fig. 27 and install the circulating pump motor starter.

2. Install the circulating pump motor starter heaters. (Para. 81).



LEGEND FOR FIGURE 27

1. Stationary contact block
2. Contact block spacer
3. Contact block cover
4. Movable contact support
5. Rear stationary contact assy.
6. Front stationary contact assy.
7. Movable contact
8. Contact spring
9. Contact block screws
10. Mounting plate & base assy.
11. Operating coil
12. Yoke retainer
13. Magnet yoke
14. Coil spring
15. Coil cover
16. Coil cover screws (4 req'd)
17. Magnet armature
18. Armature retainer
19. Retainer spring
20. Overload relay
21. Overload ratchet assy.
22. Heater element
23. Screw (2 req'd)
24. Contact block cover screws

FIGURE 27. REMOVAL AND SERVICE OF CIRCULATING PUMP MOTOR STARTER

83. Pressuretrol

a. Removal. Refer to Fig. 28 and remove the pressuretrol.

b. Cleaning and Inspection.

1. Clean the pressuretrol with a cloth dampened in an approved cleaning solvent and dry thoroughly.

2. Inspect for corrosion, broken or defective snap switch, and other damage. Replace a defective pressuretrol.

c. Installation. Refer to Fig. 28 and install the pressuretrol.

d. Adjustment.

1. Refer to the adjustment points and setting indicators in Fig. 28.

2. NOTE: REFER ONLY TO THE POUNDS PER SQUARE INCH SCALES.

3. Set the pressure adjusting screw until the low cutoff pressure is psi.

4. Set the differential adjusting screw until the differential pressure scale reads 2 psi.

NOTE: WHEN PROPERLY ADJUSTED, THE PRESSURETROL WILL SHUT DOWN THE HOT OIL HEATER WHEN THE HOT FLUID PRESSURE LOWERS TO 5 PSI AND ALLOWS THE HEATER TO BE RESTARTED WHEN THE PRESSURE RISES TO 7 PSI.

FIGURE 28. REMOVAL OF LOW LEVEL CONTROLLER ADJUSTMENTS OF HOT OIL PRESSURETROL

NOTE: DRAIN THE RESERVOIR AND EXPANSION TANK AND SURGE TANK BEFORE ANY REMOVAL. REFILL AFTER INSTALLATION (PARA. 37).

NOTE: TAG AND DISCONNECT ELECTRICAL WIRING, FOLLOWING REMOVAL OF THE COVERS.

NOTE: PRESSURETROL IS REMOVED BY TURNING COUNTER-CLOCKWISE.

MOUNTING & OPERATING INSTRUCTIONS FOR TYPE "A" CONTROL

- MOUNTING:** The type "A" Control has a 2-1/2" pipe thread and is to be mounted into either a full or one-half of a 2-1/2" pipe coupling welded into a tank. Another means of mounting is to screw the Control into a reducing flange with 2-1/2" NPT. In mounting the Control to the tank, the hex nut should be turned so that the flat of the hex with the 1/2" conduit opening is to the right and in a vertical plane. The float must move up and down in a vertical plane.
- OPERATING:** The SPDT Switch is actuated by means of a magnetic armature which in turn is actuated by the movement of the float ball. When the ball rises, the magnetic armature comes within the attraction of the Switch, opening the circuit. When the liquid level begins to fall, the float ball will pull the magnetic armature away from the attraction of the Switch, which will then make a circuit, completing the cycle.
- DIFFERENTIAL:** The type "A" Control, using a 6" float rod has an adjustable differential range of 3/4" to 5". A greater range can be had by using a longer float rod. An influencing factor in determining the differential is the specific gravity of the fluid to be controlled. The differential is adjusted by moving the stirrup either upwards or downwards. To move it upwards, will give less differential. To obtain more differential, the stirrup is to be moved downward.
- SWITCHING:** The designations of the Switches normally used are ZA and SA, both of which are SPDT - black wire being the common lead.
- On a rising liquid level: Black and white opens
Black and green closes
- On a falling liquid level: Black and white closes
Black and green opens
- Switch rating: 110 V. A.C. --- 10 Amps., 220 V. A.C. --- 5 Amps.
Max. 1/4 H.P. - A.C. Motor direct hookup
Pilot loads on D.C. only.

FIGURE 29. MOUNTING AND OPERATING INSTRUCTIONS FOR LOW LEVEL CONTROLLED

84. Low Fluid Level Cutoff

a. Removal. Refer to Fig. 28 and remove the low fluid level cutoff.

b. Cleaning and Inspection.

- 1. Clean the low fluid level cutoff with a cloth dampened in an approved cleaning solvent and dry thoroughly.**
- 2. Inspect for corrosion, broken or defective magnetic switch and other damage.**
- 3. Inspect the mounting hardware for cracks, breaks, and damaged threads.**
- 4. Replace any defective parts.**

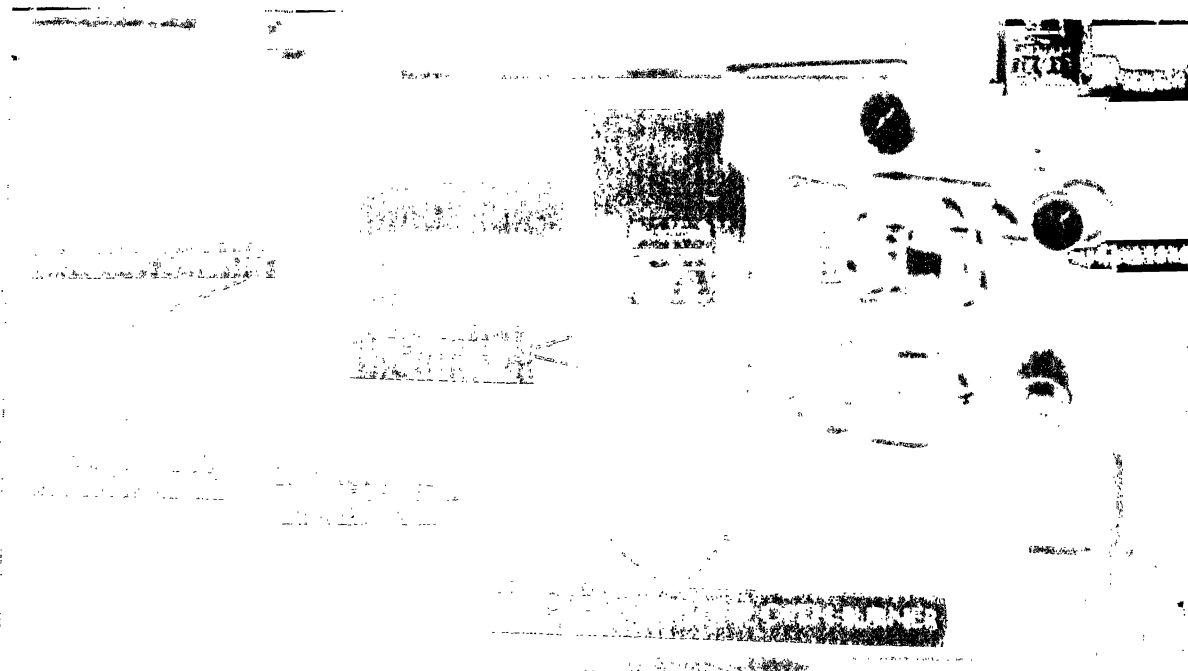
c. Installation. Refer to Fig. 28 and install the low fluid level cutoff.

d. Adjustment.

- 1. Refer to Fig. 28 and remove the low fluid level cutoff covers.**
- 2. Refer to Fig. 29 and adjust the low fluid level cutoff.**
- 3. Refer to Fig. 28 and install the low fluid level cutoff covers.**

85. Ignition Transformers

- a. Removal. Refer to Fig. 30 and remove the ignition transformer,
- b. Cleaning and Inspection.
 1. Clean all parts with a cloth dampened with an approved cleaning solvent and dry thoroughly.
 2. Inspect the transformer and gasket for defects. Inspect the bussbars for signs of arcing, overheating, and other damage.
 3. Inspect the mounting hardware for cracks, breaks, and damaged threads.
 4. Replace all defective parts.



86. U.V. Cell

a. On-Equipment Testing.

1. With a 20,000 ohms/volt test meter set on the 10 VDC scale and plugged into the test jacks on the control (Fig. 25)(top jack-bottom jack +) the flame relay will pull in at approximately 3V DC. NOTE: IF THE METER READS BACKWARDS REVERSE THE JACKS. Now, start the heater.
2. To assure sufficient margin of signal to hold in during random momentary downward fluctuations of the signal, it is desirable to obtain an average of 3.50 DC or more. A good reading will be from 3.5 V DC to 6V DC .
3. Allow the flame program control to program normally and observe a signal on the voltmeter. If the signal is below 3.5 volts, this is indicative of either A. a dirty or otherwise obscured viewing window on the U.V. Cell or B. a faulty cell. A smoky fire will also reduce detection.
4. If the U.V. Cell does not check out as described in the above, refer to Fig. 31 for removal and/or replacement.
5. If the readings are normal as indicated in "3" above, further check the U.V. Cell by shutting down the fuel supply. Within two (2) seconds of burner flameout the meter will read "0" and the burner will go into alarm requiring a manual reset. Refer to Fig. 25 to restart and recycle.

NOTE: IT IS RECOMMENDED THAT A PROCEDURE BE ESTABLISHED TO TEST AT LEAST ONCE A MONTH THE COMPLETE FLAME SAFEGUARD SYSTEM. THIS TEST SHOULD VERIFY FLAME FAILURE SAFETY SHUT-DOWN AND FUEL VALVE TIGHTNESS.

b. Removal. Refer to Fig. 31 and remove the U.V. Cell and electron tube.

c. Cleaning and Inspection.

1. Clean all parts with a cloth dampened with an approved cleaning solvent and dry thoroughly. The viewing window in particular should be clean and free of obstruction.
2. Inspect the U.V. Cell and electron tube for defects and damage. Inspect for a bent or misaligned viewing window tube.
3. Inspect mounting hardware for cracks, breaks, and damaged threads. Replace any defective parts.

d. Installation. Refer to Fig. 31 and install the U.V. Cell and electron tube.

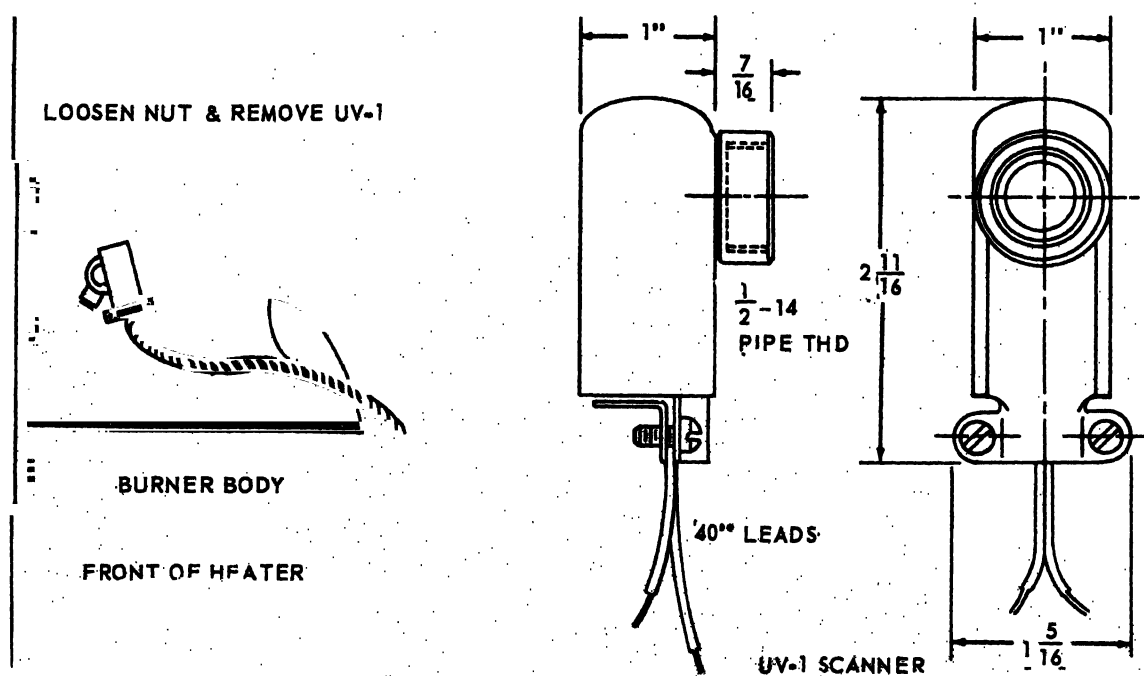


FIGURE 31. REMOVAL AND SERVICE U.V. CELL

87. Damper Cylinder Nut and Mounting

- a. General. The damper cylinder is attached to the air scoop by means of a nut threaded on the cylinder shaft which in turn passes through a mounting bracket. There is also a fuel connection in the bottom of the cylinder which supplies oil pressure for the cylinder to operate.
- b. Removal.
 1. Remove the nut by turning counter-clockwise.
 2. Remove the fuel piping, breaking union connection, and turning counter-clockwise from bottom of cylinder.
- c. Replacement
 1. Replace the nut and fuel piping by reversing steps 1 & 2 above.

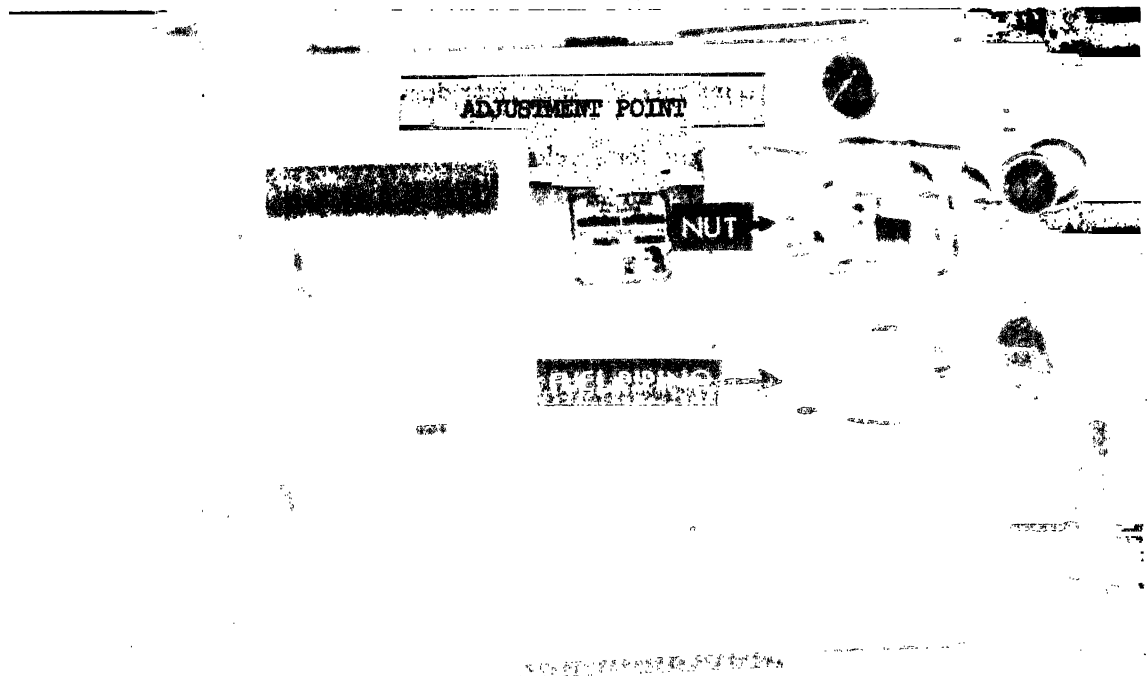


FIGURE 32. REMOVAL AND SERVICE DAMPER CYLINDER

88. Air Damper Cylinder and Damper Cylinder Linkage.

a. **General.** The Air damper cylinder controls the movements of the damper butterfly valve on the blower housing which controls the flow of air to the burner. After the flame is detected in the low fire position the high fire valve opens sending oil to the oil cylinder which in turn opens the air damper.

b. Removal.

1. Remove the cylinder nut and piping from Solenoid Valve (Para. 87).
2. Refer to Fig. 32 and remove the air damper cylinder and damper cylinder linkage.

c. Cleaning and Inspection.

1. Clean all parts with a cloth dampened in an approved cleaning solvent and dry thoroughly.
2. Inspect the air damper cylinder for damage and operation. Inspect the cylinder shaft for wear and full travel. Inspect the linkage for signs of wear, bent shafts, damaged threads, and other damage.
3. Inspect the mounting hardware for cracks, breaks, and damaged threads. Replace any defective part.

d. Installation.

1. Refer to Fig. 32 and install the air damper cylinder and the damper cylinder motor linkage.
2. Install the cylinder nut and piping from solenoid valve. (Para. 87).

e. Damper Cylinder Linkage Adjustment.

1. Refer to Fig. 32 for the linkage adjustment points.

NOTE: THE ADJUSTMENT OF THE DAMPER CYLINDER LINKAGE SHOULD BE STARTED WITH THE HOT OIL HEATER WHEN IT IS NOT OPERATING AND AFTER IT HAS BEEN COOLED TO AMBIENT TEMPERATURE.

NOTE: DO NOT ATTEMPT TO ADJUST THE DAMPER CYLINDER LINKAGE UNLESS THERE IS SOME EVIDENCE THAT LINKAGE HAS SLIPPED, SUCH AS EXCESSIVE SMOKE DURING FIRING OR WHEN CYLINDER HAS BEEN REMOVED.

2. With the burner firing and in the low fire position, adjust the linkage until the stack has a slight haze.
3. Allow the control to program into high fire, and adjust the linkage until stack

has a slight haze in high fire.

4. Turn burner switch to "OFF" position. Control will program "OFF" and burner will return to low fire. Turn burner switch on re-adjust low fire setting until stack has a slight haze. Allow control to program to high fire and repeat adjustment if necessary.
 5. Using an exhaust analyzer, test the CO₂ content at the exhaust stack. In low-fire it should be 9.0 to 10.0 per cent. At high fire, it should be 10.5 to 11.5 per cent.
 6. If the adjustment proves impossible, refer to Paras. 101 and 103, and adjust the burner electrodes and properly position the damper valve.
 7. Following positioning of the butterfly valve and adjustment of the burner electrodes, perform steps one (1) through four (4) above.
 8. Stop the hot oil heater. (Para.17).
89. Burner and Circulating Pump Switch.
- a. Removal. Refer to Fig. 33 and remove the burner switch, and circulating pump switch.
 - b. Cleaning and Inspection.
 1. Clean all parts with a cloth dampened in an approved cleaning solvent and dry thoroughly.
 2. Inspect the switch for corrosion, defective operation, or other damage. Replace a defective switch.

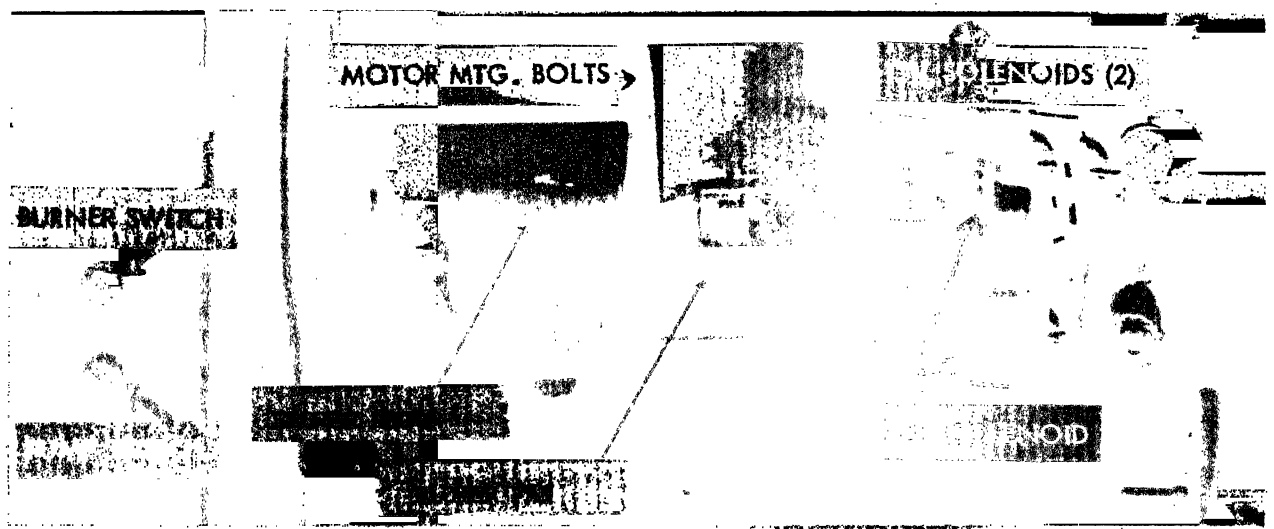


FIGURE 33 REMOVAL AND SERVICE, SOLENOIDS AND SWITCHES

90. Burner Oil Solenoids.

- a. Removal. Refer to Fig. 33 and remove the burner oil solenoids.
- b. Cleaning and Inspection.
 - 1. Clean all parts in an approved cleaning solvent and dry thoroughly.
 - 2. Inspect the burner oil valve for operation and damage. Replace a defective burner oil valve.
- c. Installation. Refer to Fig. 33 and install the burner oil solenoids

91. Blower Motor and Blower Fan.

- a. On-Equipment Testing (Direction of Rotation.)
 - 1. Start the hot oil heater (Para. 17)
 - 2. Inspect the air intake (Fig. 22) to blower housing. If suction is indicated, the direction of rotation is correct. If pressure is indicated, direction of rotation is incorrect.
 - 3. Reverse an incorrect rotation, by reversing any two of the three leads supplying current to the blower motor starter. (Para. 77).
 - 4. Stop the hot oil heater. (Para. 17).
- b. Removal.
 - 1. Remove the fuel pump. (Para. 106).
 - 2. Refer to Fig. 33 and remove the blower motor and blower fan.
- c. Cleaning and Inspection.
 - 1. Clean all parts with an approved cleaning solvent and dry thoroughly.
 - 2. Clean the blower motor with a cloth dampened with an approved cleaning solvent. Use compressed air to blow out dust and dirt from the interior of the motor.
 - 3. Inspect the blower motor for signs of damage, overheating, and shaft wear. Inspect the blower motor-to-fuel pump shaft coupling for wear and other damage.
 - 4. Inspect the mounting disk for warpage, mounting hole elongation, and other damage.
 - 5. Inspect the blower fan for bent vanes and warpage.
 - 6. Inspect the mounting hardware for cracks, breaks and damaged threads.

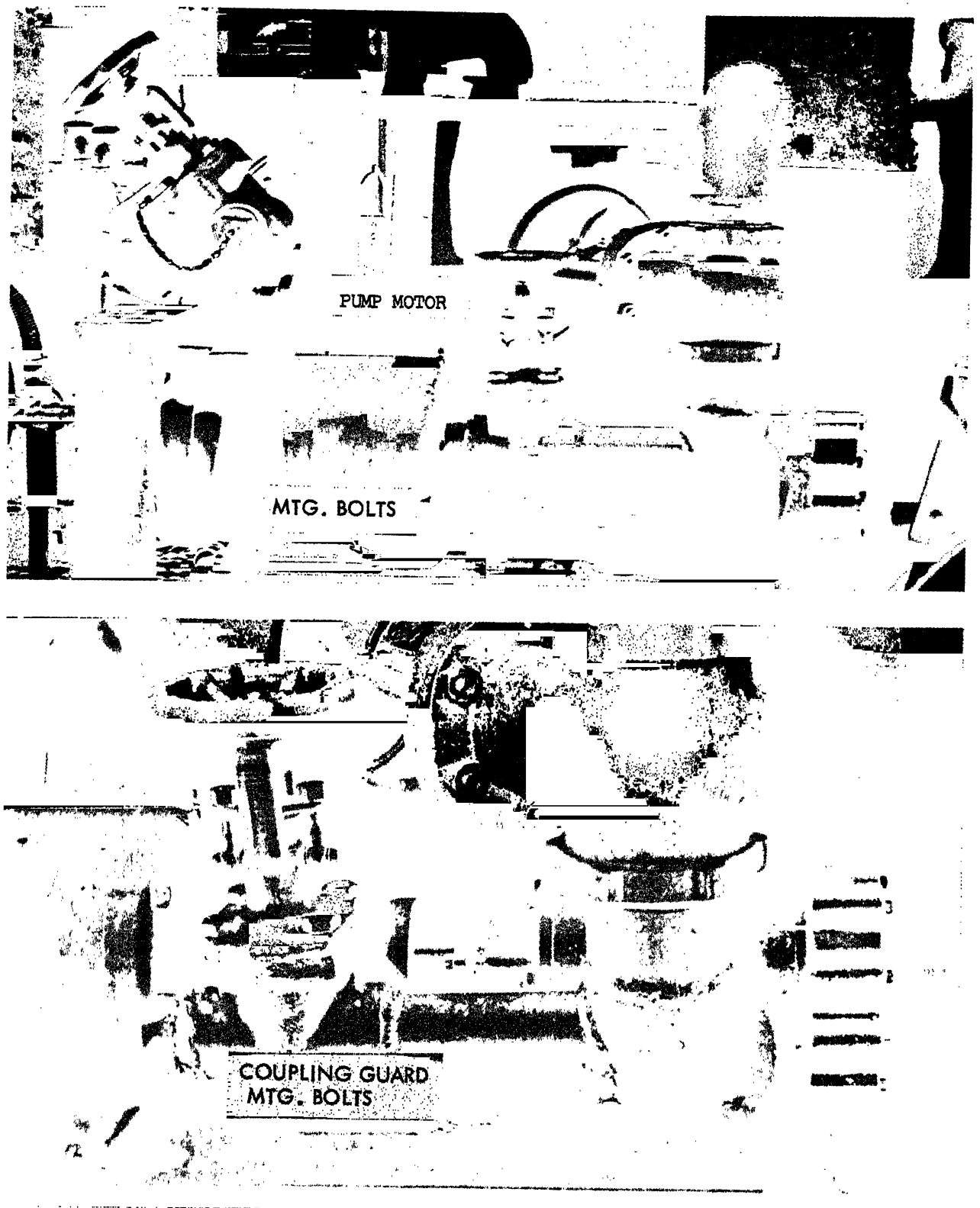


FIGURE 34. REMOVAL AND SERVICE CIRCULATING PUMP AND MOTOR.

d. Installation.

1. Refer to Fig. 33 and install the blower motor and blower fan.
2. Install the fuel pump. (Para. 106).

92. Circulating Pump Motor.

a. Removal. Refer to Fig. 34 and remove the circulating pump motor.

b. Cleaning and inspection.

1. Clean all parts with an approved cleaning solvent and dry thoroughly. Clean the circulating pump motor with a cloth dampened with an approved cleaning solvent.
2. Inspect the circulating pump motor for signs of damage, overheating and shaft wear.
3. Inspect the mounting hardware for cracks, breaks, and damaged threads. Replace a defective part.

c. Installation. Refer to Fig. 34 and install the circulating pump motor.

d. Alignment. Refer to Fig. 34 and 34A. to align the circulating pump, circulating pump motor, and pump drive coupling.

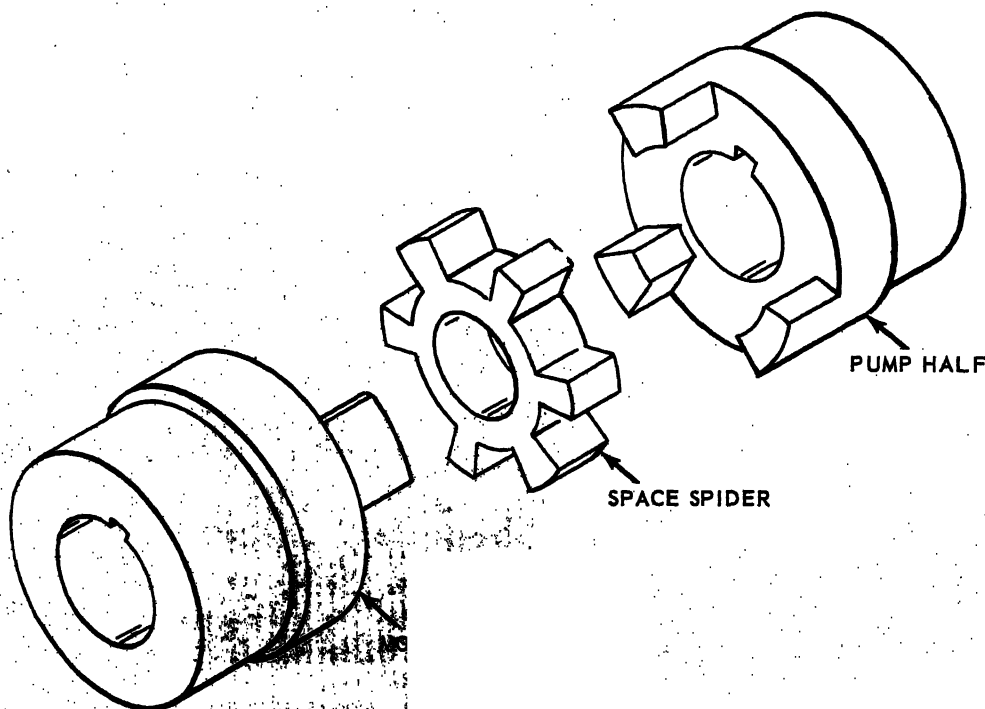


FIGURE 34A. MAIN PUMP AND MOTOR COUPLING

Section VIII HOT FLUID SYSTEM

93. General:

The components of the hot fluid system are used to circulate, clean and control the heat transfer oil. The circulating pump keeps the fluid in constant motion during operation. The fluid flows on each passing through one of the two large filters which serve to remove any sand, grit or other foreign matter from the fluid. The three-way valve is used to divert the flow of heater transfer oil to the particular strainer being used. The vent pipe assembly is used to provide a vent during operation.

**WARNING: ALLOW FOR SUFFICIENT COOLING AFTER OPERATION
BEFORE PERFORMING MAINTENANCE ON THE HOT OIL
HEATER AS SERIOUS INJURY FROM SECOND AND THIRD
DEGREE BURNS COULD RESULT.**

94. Circulating Pump, Pump Drive Coupling, and Pump Drain Line.

a. On-Equipment Testing (Direction of Rotation).

1. Start the hot oil heater. (Para. 17).
2. Refer to Fig. 34 and inspect the pump drive coupling and shaft for proper rotation. It should be clockwise, viewed from coupling end.
3. Refer to Fig. 27 and reverse an incorrect rotation, by reversing any two of the three leads from the circulating pump motor starter to the circulating pump motor.
4. Stop the hot oil heater. (Para. 17).

b. Removal. Refer to Fig. 34 and 34A. to remove the circulating pump and pump drive coupling.

c. Cleaning and Inspection.

1. Clean all parts with an approved cleaning solvent and dry thoroughly.
2. Inspect the circulating pump for leaky packing, signs of wear and other damage. Inspect the coupling for signs of wear and other damage.
3. Inspect the mounting hardware for cracks, breaks, and damaged threads. Replace any defective part.

- d. Installation. Refer to Fig. 34 and install the circulating pump and pump drive coupling.
- e. Alignment. Refer to Fig. 34 and align the circulating pump motor and pump drive coupling, and circulating pump.
- f. Packing Nut Adjustment. The two packing nuts which surround the shaft of the circulating pump are accessible from the drive end of the pump. Tighten the nuts equally or loosen equally as necessary to prevent leakage or reduce friction. In the event the nuts cannot be loosened for a friction adjustment without causing leakage, refer to Direct Support Maintenance for circulating pump overhaul.

95. Pump Base Plate.

a. Removal.

- 1. Remove the circulating pump motor. (Para. 92)
- 2. Remove the circulating pump and pump drive coupling. (Para. 94)
- 3. Refer to Fig. 34 and remove the pump base plate.

b. Cleaning and Inspection.

- 1. Clean all parts in an approved cleaning solvent and dry thoroughly.
- 2. Inspect the pump base plate for cracks, breaks, warpage and other damage.
- 3. Inspect the mounting hardware for cracks, breaks, and damaged threads. Replace any defective parts.

c. Installation.

- 1. Refer to Fig. 34 and install the pump base plate.
- 2. Install the circulating pump and pump drive coupling.
- 3. Install the circulating pump motor. (Para. 92).

96. Hot Fluid Strainers.

a. Removal. Refer to Fig. 35 and remove the hot fluid strainers.

b. Cleaning and Inspection.

- 1. Clean all parts with an approved cleaning solvent and dry thoroughly.
- 2. Inspect the hot fluid strainer housings, caps, and fittings for cracks, breaks, damaged threads, and other damage.

3. Inspect the condition of the element. Replace all defective parts.

c. Installation. Refer to Fig. 35 and install the hot fluid strainers.

97. Three-Way Valves, Lines, and Fittings.

a. Removal.

1. Remove the hot fluid strainers. (Para. 96)
2. Refer to Fig. 35 and remove the three-way valves, lines and fittings.

b. Cleaning and Inspection.

1. Clean all parts with an approved cleaning solvent and dry thoroughly.
2. Inspect the three-way valves, lines and fittings, for cracks, breaks, damaged threads, and the valves for operation.
3. Replace all defective parts.

c. Installation.

1. Refer to Fig. 35 and install the three-way valves, lines and fittings.
2. Install the hot fluid strainers. (Para. 96).

98. Vent Pipe Assembly.

a. Removal. Refer to Fig. 36 and remove the vent pipe assembly.

b. Cleaning and Inspection.

1. Clean all parts with an approved cleaning solvent and dry thoroughly.
2. Inspect the vent piping and plugs for cracks, breaks, damaged threads and other damage.
3. Inspect the vent plug retaining chain for condition.
4. Replace a defective part.

Section IX. BURNER ASSEMBLIES

99. General.

The burner assembly consists of the rear plate viewer assembly, used to observe the condition and color of the flame; the blower, which supplies the air to the burner; the burner head, where the air, fuel, and spark are mixed to create the flame; and the exhaust stack, which vents the combustion residues to the atmosphere.

**WARNING: ALLOW FOR SUFFICIENT COOLING
AFTER OPERATION BEFORE PERFORM-
ING MAINTENANCE ON THE BURNER
COMPONENTS AND AUXILIARIES.**

100. Rear Plate Viewer Assembly.

- a. Removal. Refer to Fig. 36 and remove the rear plate viewer assembly.
- b. Cleaning and Inspection.
 1. Clean all parts with a cloth dampened in an approved cleaning solvent.
 2. Inspect the rear plate viewer assembly for cracked or broken lenses, damaged threads, and other damage.
 3. Replace all defective parts.
- c. Installation. Refer to Fig. 36 and install the rear plate viewer assembly.

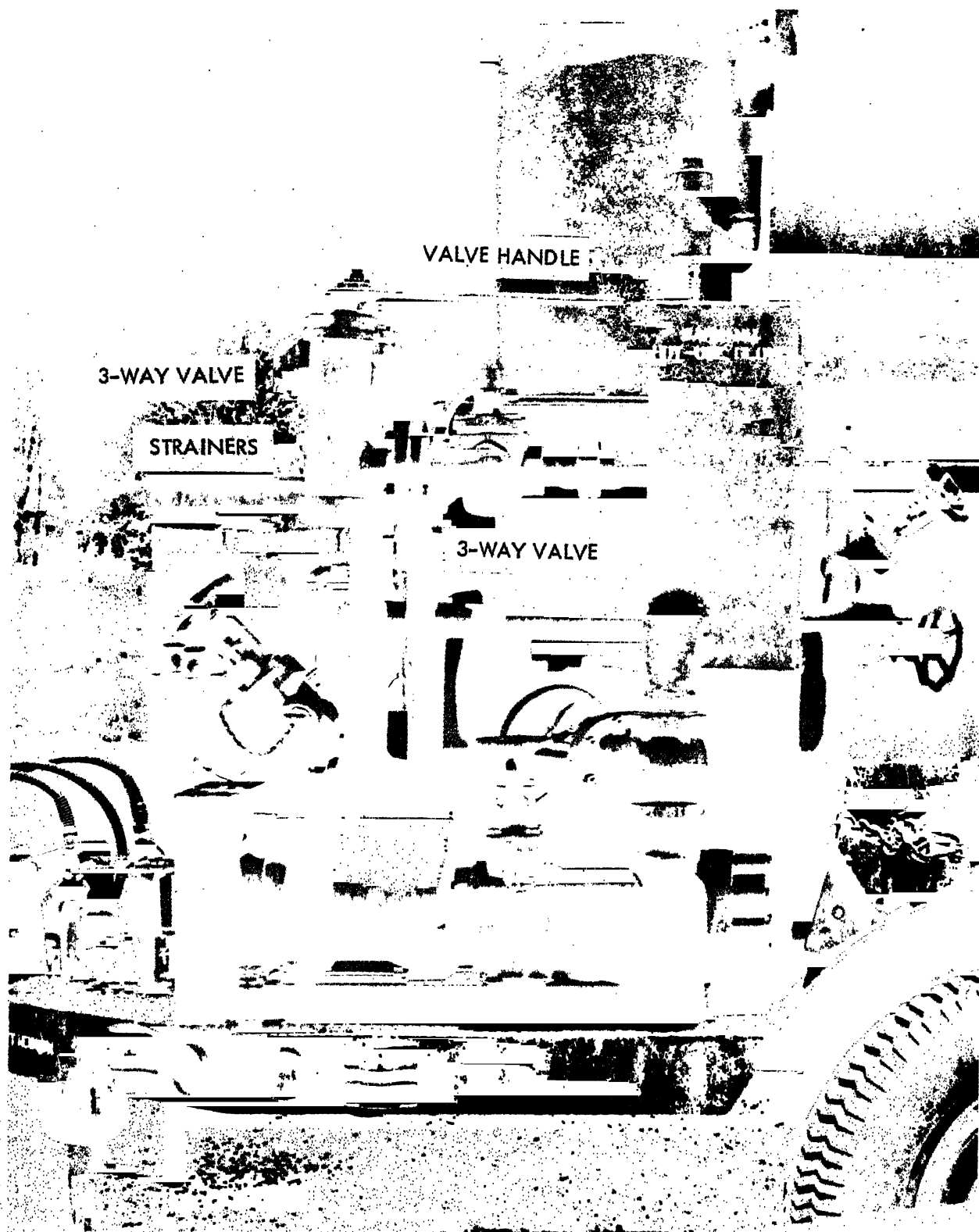


FIGURE 35. REMOVAL AND SERVICE OF HOT OIL STRAINERS AND THREE WAY VALVES

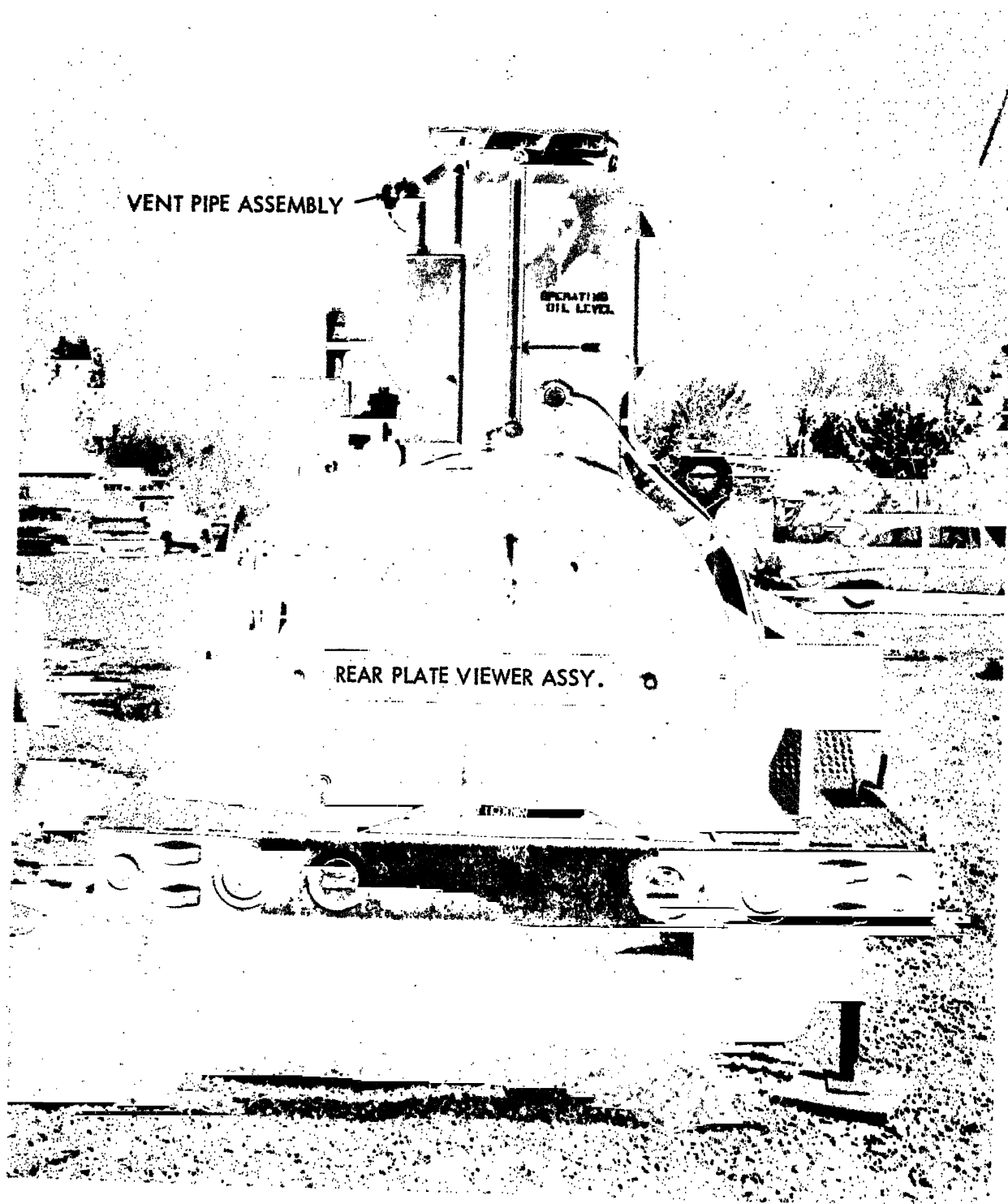


FIGURE 36. REMOVAL AND SERVICE TO VENT PIPE ASSEMBLY

101. Blower.

a. Removal.

1. Remove the blower motor. (Para. 91)
2. Remove the air damper cylinder linkage. (Para. 88)
3. Refer to Figures 37 and 38 and remove the blower.

b. Disassembly. Refer to Fig. 38 and disassemble the blower.

c. Cleaning. Inspection and Repair.

1. Clean all parts with an approved cleaning solvent and dry thoroughly.
2. Inspect the blower housing for cracks, dents, breaks, and elongated mounting holes.
3. Inspect the mounting flange, air dampers, and linkage for cracks, breaks, and other damage.
4. Inspect the mounting hardware for cracks, breaks and damaged threads.
5. Inspect for proper positioning of the air dampers.
6. Pound out dents and weld minor breaks, in the blower housing.
7. Straighten a bent air damper and adjust the air damper to proper position in relation to the control linkage.
8. Replace a defective part.

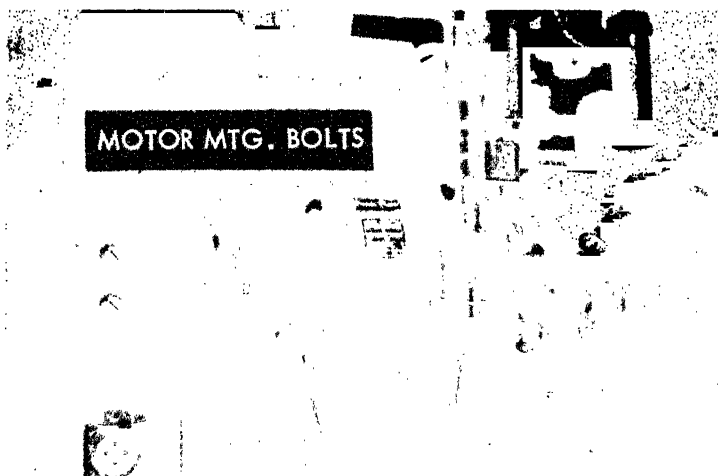


FIGURE 37. REMOVAL AND SERVICE TO BLOWER

- d. Air damper positioning. Position the air damper (Fig. 38) to the control linkage in such a manner that in the open position, the lower end of the control linkage will be nearest the blower housing.
- e. Reassembly. Refer to Fig. 38 and reassemble the blower.
- f. Installation.
 1. Refer to Fig. 37 and install the blower.
 2. Install the damper motor linkage. (Para. 88).
 3. Install the blower motor. (Para. 91).

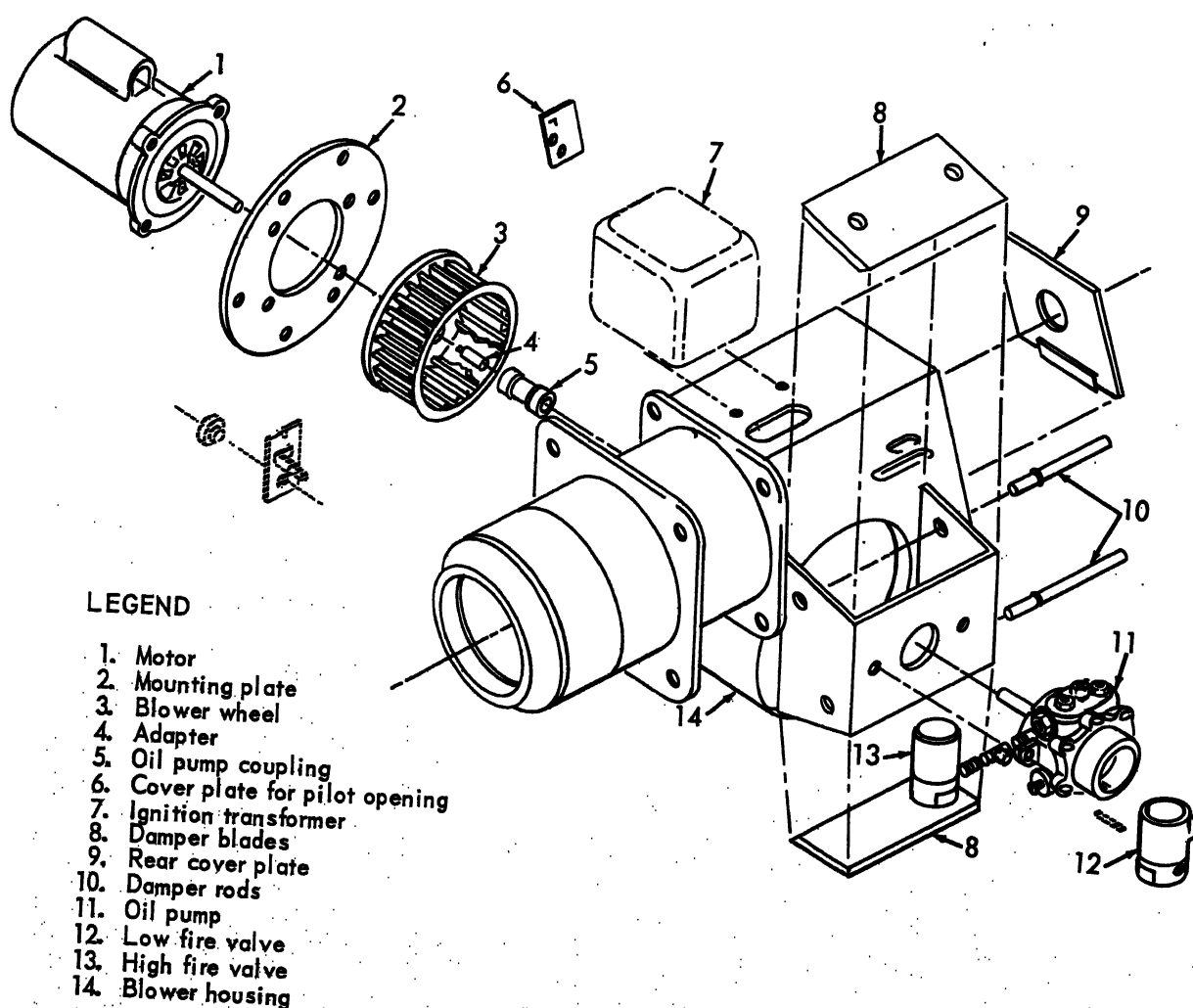


FIGURE 38. BLOWER DISASSEMBLY

102. Blower Head.

a. Removal.

- 1. Remove the Blower. (Para. 101).**
- 2. Refer to Fig. 61A and remove the burner head.**

b. Cleaning and Inspection.

- 1. Clean the burner head with an approved cleaning solvent and dry thoroughly.**
- 2. Inspect the burner head for damaged or defective nozzles and electrodes and other damage.**
- 3. Replace a defective burner head.**

c. Installation. Refer to Fig. 61A and install the burner head.

FIGURE 39 NOT APPLICABLE

FIGURE 40 PAGE 94 "NOT APPLICABLE"

103. Burner Electrode Adjustment.

- a. Removal for Adjustment. Refer to Fig. 61B and remove the drawer assembly.
- b. Cleaning and Inspection.
 1. Clean the electrodes with an approved cleaning solvent and dry thoroughly. Remove any carbon deposits that may have formed on the electrodes.
 2. Inspect for broken electrodes, both metal and ceramic portions. Inspect for other damage.
 3. If the electrodes or the nozzles are defective, replace the defective parts.
- c. Adjustment. Refer to Fig. 61B and adjust the burner electrodes.
- d. Installation Following Adjustment. Refer to Fig. 61B and install the drawer assembly.
- e. Electrode Spark Inspection Following Adjustment.
 1. Refer to Para. 17 and start the hot oil heater.
 2. Refer to Fig. 36 and view the electrode spark through the rear plate viewer assembly. Spark should be a bright blue if electrodes are properly adjusted.
 3. If spark is red or yellow, or any other color than bright blue, readjust the ignition electrodes. (See a through d, above).

104. Burner Exhaust Stack.

a. Removal. Refer to Fig. 41 and remove the burner exhaust stack.

b. Cleaning and Inspection and Repair.

- 1. Clean all parts in an approved cleaning solvent and dry thoroughly.**
- 2. Inspect the exhaust stack and rain cap for dents, cracks, breaks and other damage. Inspect the rain cap hinge for operation and damage.**
- 3. Inspect mounting hardware for cracks, breaks, and damaged threads.**
- 4. Straighten out dents and warpage and weld minor breaks in the exhaust stack or rain cap. Replace defective parts.**

c. Installation. Refer to Fig. 41 and install the burner exhaust stack.

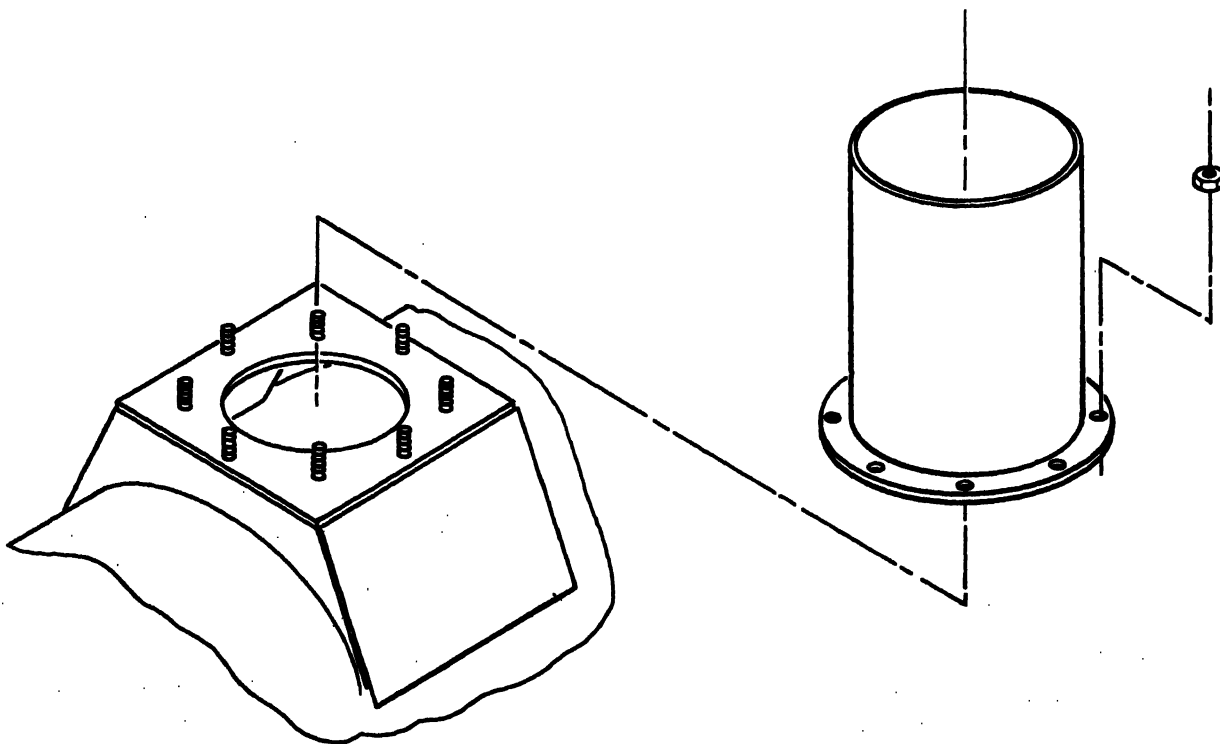


FIGURE 41. REMOVAL OF STACK

Section X. FUEL SYSTEM

105. General.

The fuel system consists of a two-stage fuel pump, which is operated by the blower motor, fuel lines between the pump and the burner oil valves, and fuel lines between the fuel pump and the fuel oil strainers. Selector fuel oil valves mounted near the fuel oil strainers provide optional use of the strainers.

106. Fuel Pump.

- a. Removal. Refer to Fig. 42 and remove the fuel pump.
- b. Cleaning and Inspection.
 1. Clean the fuel pump with a cloth dampened in an approved cleaning solvent.
 2. Inspect the fuel pump for damaged fittings, signs of leaking, and other damage.
 3. Inspect the mounting hardware for cracks, breaks, and damaged threads. Replace all defective parts.
- c. Installation. Refer to Fig. 42 and install the fuel pump.
- d. Adjustment. Refer to Fig. 22 and adjust the fuel pump.

- A. DISCONNECTING AND CONNECTING THE FUEL PUMP-TO-BLOWER MOTOR COUPLING.
- B. FUEL PUMP, REMOVAL AND INSTALLATION.

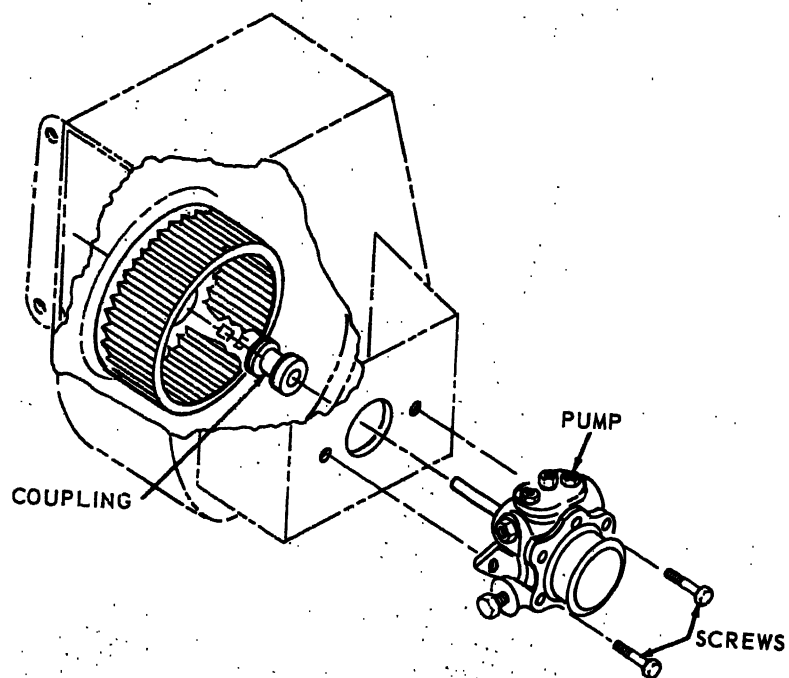


FIGURE 42. FUEL PUMP DISASSEMBLY

107. Fuel Oil Strainers.

- a. Removal. Refer to Fig. 43 and remove the fuel oil strainers.
- b. Cleaning and Inspection.
 1. Clean all parts with an approved cleaning solvent and dry thoroughly.
 2. Inspect the fuel oil strainers for cracks, breaks, warpage and other damage.
 3. Inspect the cap mounting hardware for cracks, breaks, and damaged threads.
 4. Install new gaskets and filters, defective parts should be replaced.
- c. Installation. Refer to Fig. 43 and install the fuel oil strainers.

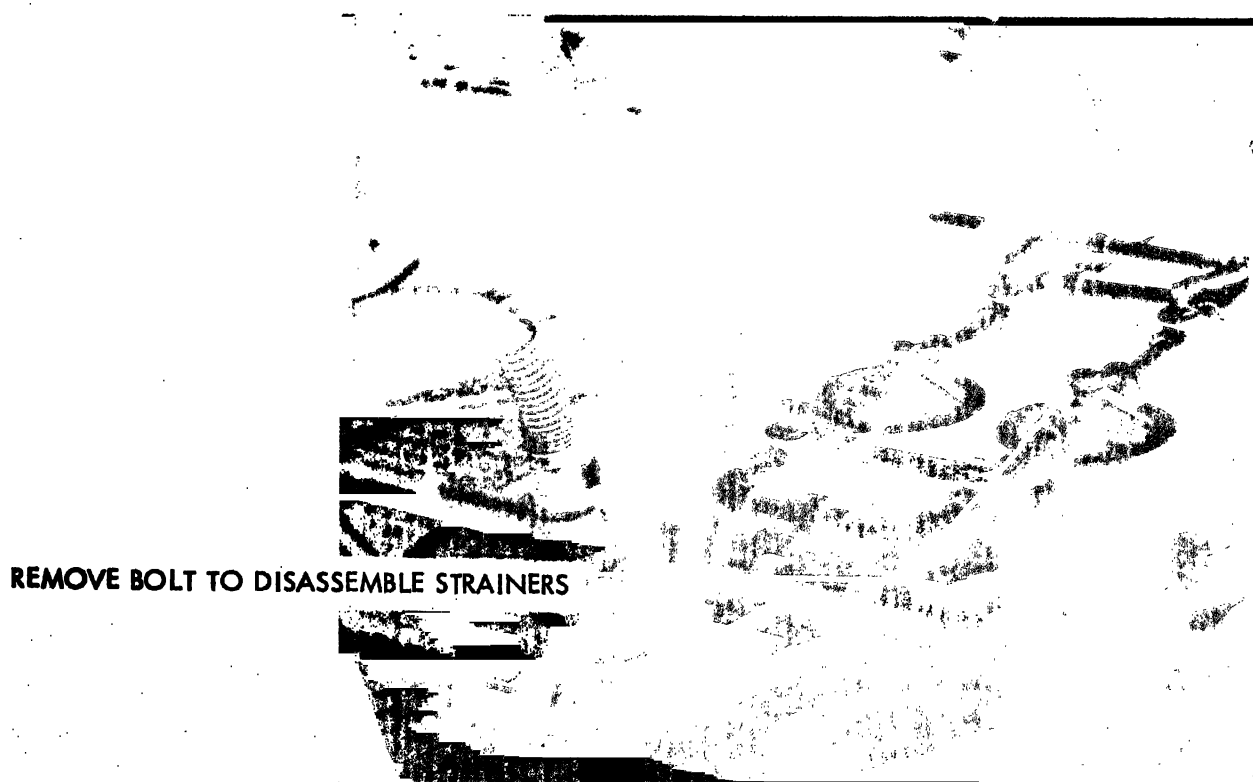


FIGURE 43. REMOVAL AND SERVICE OF FUEL OIL STRAINERS

108. Fuel Oil Valves and Fuel Oil Lines and Fittings.

a. Removal.

1. Remove the fuel oil strainers. (Para. 107)
2. Refer to Fig. 43 and remove the fuel oil valves, fuel oil lines and fittings.

b. Cleaning and Inspections.

1. Clean the fuel oil lines and valves in an approved cleaning solvent and dry thoroughly. Blow out the lines with compressed air.
2. Inspect the fuel oil lines and fittings for restrictions, damaged threads and other damage.
3. Inspect the valves for operation and damage.
4. Replace all defective parts.

c. Installation.

1. Refer to Fig. 43 and install the fuel oil valves and fuel oil lines and fittings.
2. Install the fuel oil strainers. (Para. 107).

Section XI. GAGES

109. General.

There are three direct indicating gages on the hot oil heater used to indicate conditions regarding the heat transfer oil. The hot oil pressure gage and hot oil temperature gage indicate actual operating pressure and temperature of the transfer oil. The liquid level sight gage indicates that the expansion tank is full or nearly full, at a safe operating level, or that the hot oil heater is approaching shut down because of insufficient heat transfer oil.

110. Hot Oil Pressure Gage, and Lines and Fittings.

a. Removal.

1. Refer to Fig. 44 and remove the hot oil pressure gage, and lines and fittings.

b. Cleaning and Inspection.

1. Clean the hot oil pressure gage with a cloth dampened with an approved cleaning solvent and dry thoroughly.

2. Clean the remaining parts with an approved cleaning solvent and dry thoroughly. Blow lines clean with compressed air.
3. Inspect the hot oil pressure gage for cracked or broken glass or dial, defective threads, or other damage.
4. Inspect the lines and fittings for cracks, breaks, signs of leakage, restrictions, and damaged threads.
5. Replace all defective parts.

c. Installation.

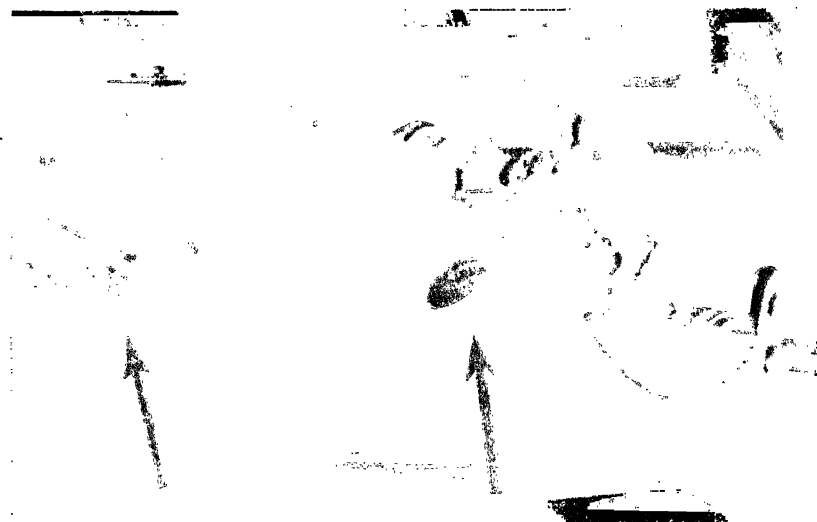
1. Refer to Fig. 44 and install the hot oil pressure gage, and lines and fittings.
2. Install the pressuretrol. (Para. 83).

111. Hot Oil Temperature Gage.

- a. Removal. Refer to Fig. 44 and remove the hot oil temperature gage.
- b. Cleaning and Inspection.
 1. Clean the hot oil temperature gage with a cloth dampened with an approved cleaning solvent.
 2. Inspect the gage for cracked or broken dial or glass, for correct indication, and other damage. Replace all defective parts or a defective gage.
- c. Installation. Refer to Fig. 44 and install the hot oil temperature gage.

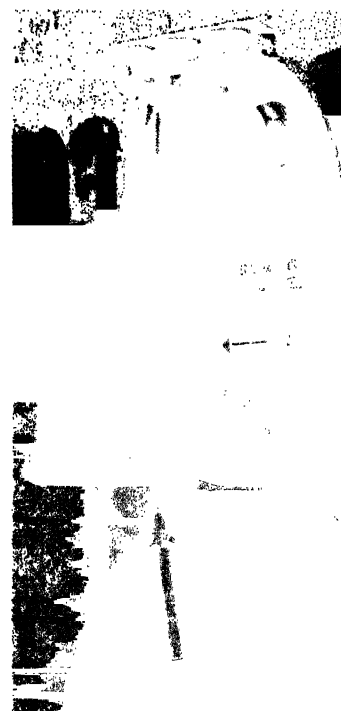
112. Liquid Level Sight Gage.

- a/ Removal. Refer to Fig. 44 and remove the liquid level sight gage.
- b. Cleaning and Inspection.
 1. Clean all parts in an approved cleaning solvent and dry thoroughly.
 2. Inspect for broken or cracked glass, damaged threads, and other damage. Replace all defective parts.
- c. Installation. Refer to Fig. 44 and install the liquid level sight gage.



HOT OIL PRESSURE GAGE

HOT OIL TEMPERATURE GAGE



LIQUID LEVEL SIGHT GAGE

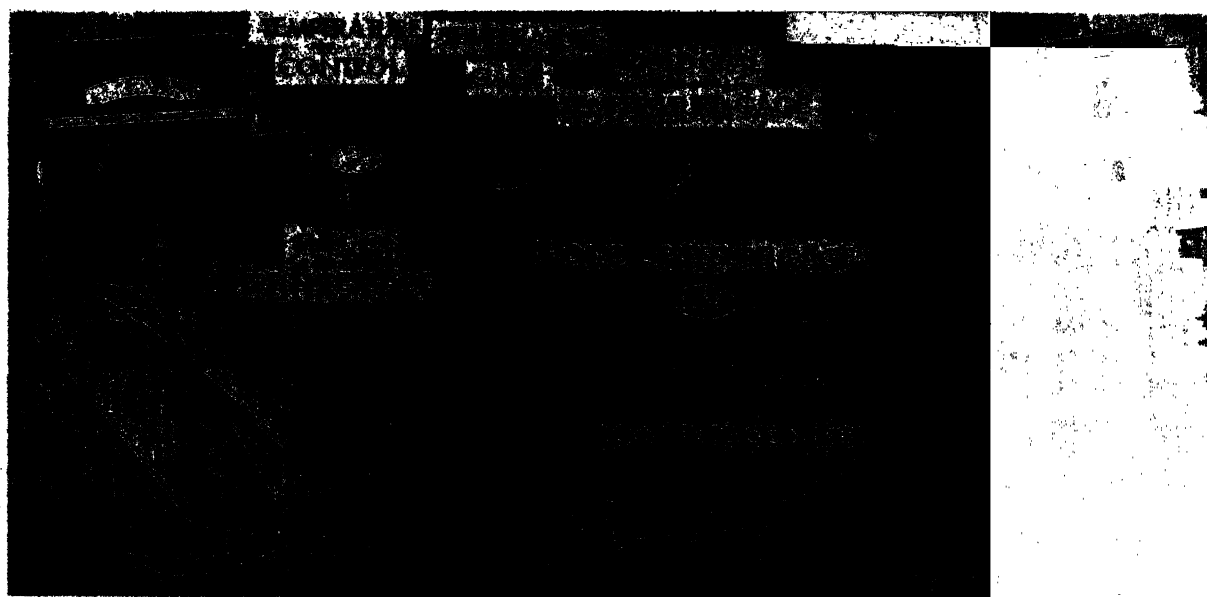


FIGURE 44. REMOVAL AND SERVICE OF LEVEL, GAGES AND CONTROLS

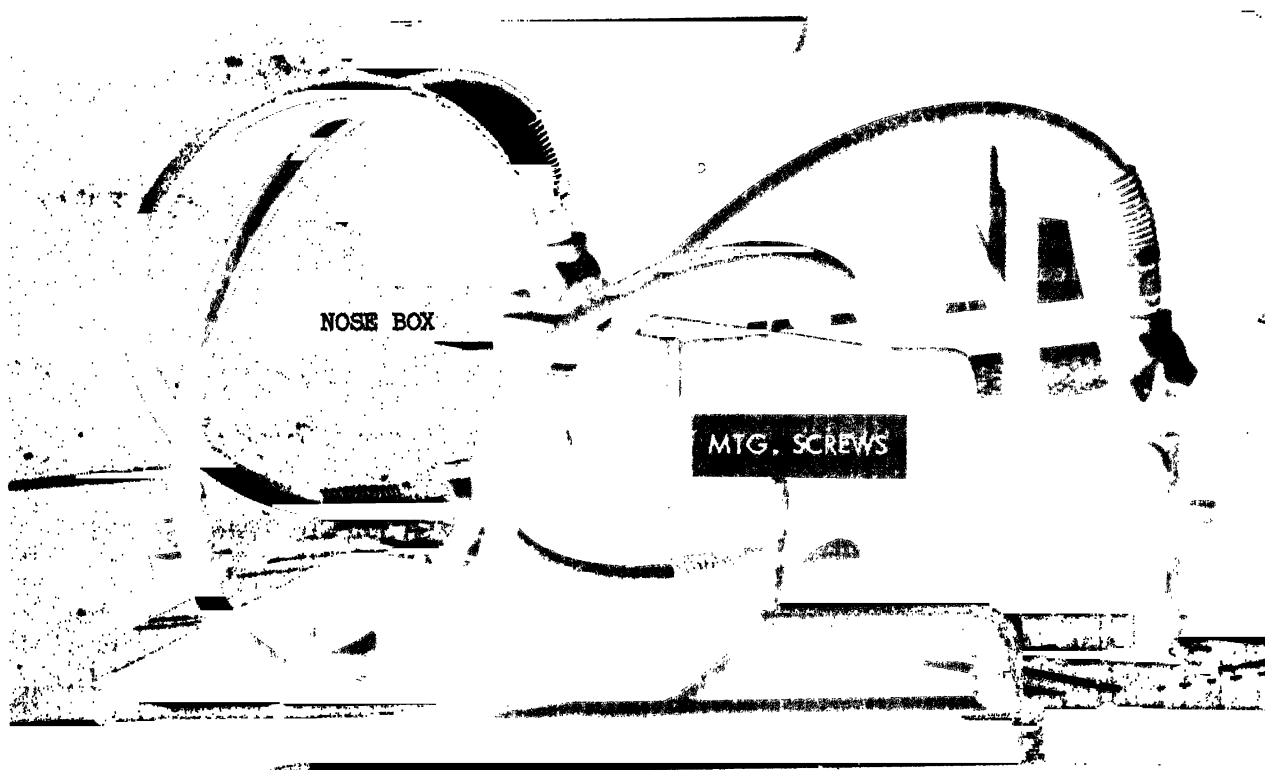


FIGURE 45

Section XII. HOSE CARRIERS, TOOLBOX, NOSE BOX,
MUD GUARDS, AND CABLE REEL.

113. General. The tool box mounted on the right side is provided for the storage of the ground rods, the normal maintenance tools; and hot oil transfer flexible hose. These may be reached by opening the hinged lid to remove them. The mud guards are attached to the rear of the fender platform and are so placed to stop and scatter road debris thrown by the wheels when the hot oil heater is in transport. The nose box plate combines the air connections for brakes and the inter-vehicular wiring receptacle in an accessible location. The circuit breakers for the lights are also located in the nose box. The cable reel is a hand operated type reel provided as a means of storing the 100 foot power cable.

114. Hose Carrier. (Integral with Tool Box)

- a. Removal. The hose carrier is attached to mounting brackets and should not be removed unless it is damaged by bending and has to be replaced.
- b. Cleaning and Inspection.
 1. Clean the hose carrier with an approved cleaning solvent and dry thoroughly.
 2. Inspect the hose carrier for cracks, breaks and other damage.
 3. Inspect periodically for indications of moisture inside the carrier.

NOTE: THE CARRIER HAS A HOLE DRILLED IN EACH END TO PERMIT ANY MOISTURE ACCUMULATION TO DRAIN TOWARD THE OPENING THEREBY DRAINING IT.

115. Tool Box. (Integral with Hose Carrier)

- a. Removal.
 1. Remove any item which might be in the toolbox. (Para. 9)
 2. Refer to Fig. 46 and remove the tool box.
- b. Cleaning and Inspection.
 1. Clean all parts with an approved cleaning solvent and dry thoroughly.
 2. Inspect for cracks, breaks, defective hinges or latches, or other damage.
 3. Inspect the mounting hardware for cracks, breaks, or damaged threads. Replace any defective part.
- c. Installation. Refer to Fig. 46 and install tool box.

116. Nose Box.

- a. Removal. Refer to Fig. 45 and remove the nose box.
- b. Cleaning and Inspection.
 - 1. Clean all parts with an approved cleaning solvent and dry thoroughly.
 - 2. Inspect the air connections for the condition of the rubber seals in the glad-hands. Inspect the wiring terminals for damaged threads, loose connections or broken or cracked mounting.
 - 3. Replace any defective or damaged parts.
- c. Installation. Refer to Fig. 45 and install the nose box.

117. Mud Guards.

- a. Removal. Refer to Fig. 47 and remove the mud guards.
- b. Cleaning and Inspection.
 - 1. Clean the mud guards with a solution of soap and water and dry thoroughly.
 - 2. Clean all metal parts with an approved cleaning solvent and dry thoroughly.
 - 3. Inspect the mud guards for rips and tears and elongated and torn out mounting holes. Inspect the mounting bars for bends, breaks, and rust.
 - 4. Inspect the mounting hardware for cracks, breaks, rust, and damaged threads. Replace all defective parts.
- c. Installation. Refer to Fig. 47 and install the mud guards.

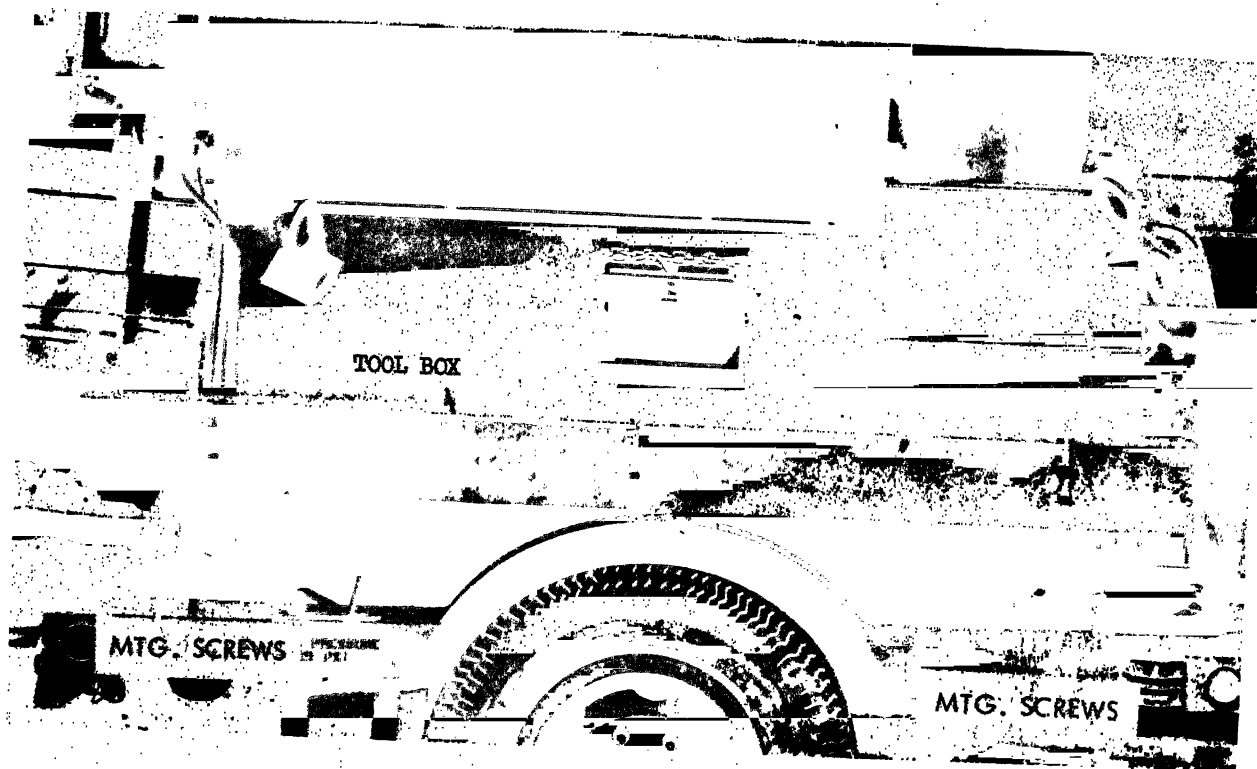


FIGURE 46. REMOVAL OF TOOL BOX



FIGURE 47. REMOVAL OF MUD GUARDS AND CABLE REEL

118. Cable Reel.

- a. Removal. Refer to Fig. 47 and remove the cable reel.
- b. Cleaning and Inspection.
 1. Clean all parts with an approved cleaning solvent and dry thoroughly.
 2. Inspect the reel assembly for cracks, distortion, and wear.
 3. Inspect the mounting hardware for cracks, breaks, and damaged threads.
- c. Installation. Refer to Fig. 47 and install the cable reel.

CHAPTER 4

DEMOLITION OF MATERIAL TO PREVENT ENEMY USE

119. General.

When capture or abandonment of the hot oil heater to an enemy is imminent, the responsible unit commander must make the decision either to destroy the equipment or to render it inoperative. Based on this decision, orders are issued which cover the desired extent of destruction. **WHATEVER METHOD OF DEMOLITION IS EMPLOYED, IT IS ESSENTIAL TO DESTROY THE SAME VITAL PARTS OF ALL HOT OIL HEATERS AND ALL CORRESPONDING REPAIR PARTS.** This will prevent utilization of parts from several units to reconstruct one operative unit.

120. Demolition To Render the Hot Oil Heater Inoperative.

a. Demolition by Mechanical Means. Use sledge hammers, crowbars, picks, axes, or other heavy tools or implements which may be available to destroy the following components of the hot oil heater:

1. Control Panel..
2. Blower Motor.
3. Blower Housing.
4. Circulating Pump Motor Starter.
5. Burner Plates.
6. Temperature Controller.
7. Ignition Transformer.
8. U.V. Cell.
9. Circulating Pump Motor.
10. Circulating Pump.

b. Demolition by Misuse. Perform the following steps to render the hot oil heater inoperative:

1. Put sand, gravel, broken glass, or other foreign material in the expansion tank and external fuel tank.

2. Remove the fuel oil strainers and the hot fluid strainers.
3. Set the maximum heat control indicating needle to the highest heat possible on the temperature controller.
4. Close the lower three-way valve and operate the heater.

NOTE: THE ABOVE STEPS ARE MINIMUM REQUIREMENTS FOR THIS METHOD.

121. Demolition by Explosives or Weapons Fire.

- a. Explosives. Place as many of the following charges as the situation permits and detonate them simultaneously with detonating cord and a suitable detonator.

1. One 1/2 pound charge inside the control panel.
2. One 1/2 pound charge on the blower housing.
3. One 1/2 pound charge under the circulating pump.
4. One 1/2 pound charge under the pump motor.

NOTE: THE ABOVE CHARGES ARE THE MINIMUM REQUIREMENT FOR THIS METHOD.

- b. Weapons Fire. Fire on the hot oil heater with the heaviest practical weapon available.

122. Other Demolition Methods.

- a. Scattering and Concealment. Remove all easily accessible parts and scatter them through dense foliage, bury them in the ground or throw them into any nearby body of water. The wider the area of scattering, the more difficult it will be to reconstruct a usable unit.

- b. Submersion. Totally submerge the hot oil heater in a body of water to provide water damage and concealment. Salt water will cause greater damage than fresh water.

123. Training.

All operators should receive thorough training in the destruction of the hot oil heater. (FM 5-25). Simulated destruction, using all of the methods listed above, should be included in the operator training program. It must be emphasized in training, that demolition operations usually are necessitated by critical situations when time available for carrying out destruction is limited. For this reason, it is necessary that operators be thoroughly familiar with all methods of destruction of the equipment, and be able to carry out demolition instructions without reference to this or any other manual, and to do so in a minimum amount of time, and in such a manner as to render the equipment totally inoperative in the hands of enemy agents.

FIGURE 48

NOT APPLICABLE

PAGE 110

NOT APPLICABLE

CHAPTER 5

SHIPMENT AND LIMITED STORAGE OF THE HOT OIL HEATER

Section 1. SHIPMENT WITHIN ZONE OF INTERIOR

124. Preparation of Equipment for Shipment.

a. General. Detailed instructions for the preparation of the hot oil heater for domestic shipment are outlined within this paragraph. Preservation will be accomplished in sequence that will not require the operation of previously preserved components.

b. Inspection. Equipment will be inspected for any unusual conditions of damage, rusting, accumulation of water, and pilferage (stolen parts, components, etc.). Refer to paragraph 38 and perform quarterly preventive maintenance services. Prepare DA Form 2404 (Equipment Inspection and Maintenance Worksheet). Correct all deficiencies before shipment.

c. Cleaning and Drying. Clean and dry the hot oil heater by an approved method before applying preservatives. Approved methods of cleaning, drying, types of preservatives, and methods of application are described in TM 38-230.

d. Painting. Paint all surfaces when the paint has been removed or damaged by wear or otherwise. Refer to TM 9-213 for the detailed cleaning and painting instructions.

e. Depreservation Guide. Concurrently with preservation of the hot oil heater, complete a DA Form 2258 (Depreservation Guide for Vehicles and Equipment). Outline any peculiar requirements in blocks 27 through 33. Place the completed depreservation guide in a waterproof envelope marked, "Depreservation Guide", and fasten the envelope in a conspicuous location on or near the operator's controls.

f. Lubrication System. Inspect the level of the lubricant in the circulating pump and add lubricant if necessary. Operate the hot oil heater until lubricant has penetrated the moving parts. Drain the circulating pump drive housing.

g. Hot Fluid System. Inspect the level of the heat transfer oil in the surge and reservoir and expansion tanks. Operate the hot oil heater until the transfer oil has been circulated throughout the system. Drain the tanks and reinstall the drain plug.

h. Sealing of Openings. Openings that will permit the direct entry of water into the interior of the hot oil heater or components will be sealed with pressure sensitive tape conforming to Specification PPP-TT-60, Type III, Class 1.

i. Exterior Surfaces. Coat exposed machined ferrous metal surfaces with preservative (P-6 conforming to Specification MIL-C-11796, Class 3. If preservative is not available, Automobile and Artillery Grease (GAA) may be used as a substitute.

j. **Basic Issue Items.** Basic issue items will be packed in a suitable container in conjunction with the shipment of the hot oil heater.

k. **Marking.** Mark the hot oil heater for shipment in accordance with Specification, MIL-STD-129.

125. Loading Equipment for Shipment.

a. **Loading.** Refer to paragraph 6 and load the hot oil heater on the carrier.

b. **Blocking.** Provide suitable blocking and tie downs to prevent the trailer mounted hot oil heater from shifting during transport by flatcar.

c. **WARNING: IF LIFTING IS REQUIRED, DO NOT USE A LIFTING DEVICE WITH A CAPACITY OF LESS THAN 10,000 POUNDS. DO NOT ALLOW THE UNIT TO SWING OR SWAY WHILE SUSPENDED. FAILURE TO OBSERVE THIS WARNING MAY RESULT IN SERIOUS INJURY OR DEATH TO PERSONNEL AND DAMAGE TO THE EQUIPMENT.**

126. Preparation of Equipment for Storage.

a. **General.** Limited storage is defined as storage not to exceed six (6) months. Instructions for preparing the hot oil heater are outlined in b and c below, and in Paragraphs 124 c, through 124 i.

b. **Basic Issue Items.** Basic issue items will be packed in a suitable container and secured to the hot oil heater to prevent loss or pilferage. Refer to TM 38-230 for container selection.

c. **Weatherproofing.** Covered storage is preferred for the hot oil heater. When suitable shelter is not available, select a firm level, well drained storage location, protected from prevailing winds. Position the hot oil heater on a solid surface. Cover the hot oil heater with a tarpaulin or other suitable waterproof covering and tie down securely on all sides.

127. Inspection and Maintenance of Equipment in Storage.

a. **General.** When the hot oil heater has been placed in limited storage, all scheduled preventive maintenance services, including inspection, will be suspended, and preventive maintenance inspection will be performed as specified herein. Perform quarterly preventive maintenance services when the unit is initially placed in limited storage and every 90 days thereafter. Record all deficiencies and shortcomings, together with corrective action taken thereon, on DA Form 2404. Required maintenance will be performed promptly to insure that the unit is mechanically sound and ready for immediate use when necessary. At the time of quarterly inspection and maintenance, operate the unit long enough to bring it up to operating temperature and insure complete lubrication of all bearings, etc. After each operating period, preserve the hot oil heater as outlined in Para. 126.

DIRECT AND GENERAL SUPPORT AND DEPOT MAINTENANCE INSTRUCTIONS

128. Scope .

129. Record and Report Forms.

Section 11. DESCRIPTION AND DATA

130. Description.

131. Direct and General Support and Depot Maintenance Tabulated Data.

- b. Circulating Pump Motor Rebuild Data.**

[illegible]

Dipping compound-----Varnish, type AN, Grade
CA, MIL-V 1137A
Compound dipping temperature -----77° F.
Stator preheat temperature-----195° to 150° F.

Number of dips -----Single
 Length of dip-----3 to 7 minutes
 Baking time-----2 1/2 to 3 hours.
 Baking temperature -----295 ° to 310° F.
 Wire Size -----No. 16 AWG

3. Circulating Pump Motor Data

Load rpm (Full) ----- 1750 rpm
 Load amperage (Full)----- 20 amps
 Locked rotor or stall amperage----- 120 amps
 NEMA code ----- G
 NEMA type ----- B

4. Circulating Pump Motor Torque Data.

Full load torque ----- 11.2 feet-pounds
 Locked rotor or stall torque ----- 18.8 feet-pounds
 d Breakd v: torque ----- 24.1 feet-pounds

5. Circulating Pump Motor Bearing Data.

Bearing part numbers:
 Shaft End Bearing ----- AFBMA 206
 Fan End Bearing ----- AFBMA 206

6. Circulating Pump Rebuild Data.

Rotation ----- Counter clockwise, viewed
 from coupling end.
 Casting thickness----- 3/8 in. minimum
 Bearing part numbers:
 Front bearing ----- Orange #E7274CT
 Rear bearing ----- Orange #E7274CT
 Bearing lubrication----- SAE 20 OIL
 Rotor type ----- Herringbone gear.
 Rotor clearance to backhead.----- 0.010 inches
 Packing:
 Size ----- 1/4 square inches.
 Number of rings ----- 7
 Stuffing Box Dimensions:
 Length (depth) ----- 3/4 inches.
 Bore diameter ----- 1 3/8 inches, inside
 diameter
 Shaft sleeve diameter ----- 7/8 inches
 Pump shaft dimensions:
 Shaft dimension between thrust and radial
 bearings, center line to center line - 4 1/4 inches
 Shaft diameter between rotor ---1 1/4 inches
 Coupling diameter -----7/8 inches

c. Blower Motor Rebuild Data.

1. Stator Winding Data.

Number of slots ----- 24
Number of coils ----- 24, single concentric
wound
Number of turns per coil ----- 36
Wire Size ----- No. 20 AWC
Coil throw ----- Slot 1 to slot 8.

2. Insulation Data

Dipping compound ----- Varnish, type AN, grade
CB, MIL-V 1137A
Compound dipping temperature ----- 115 °
Stator preheat temperature ----- 325 °
Number of dips ----- Single
Length of dip ----- 20 seconds
Baking time ----- 2 hours
Baking temperature ----- 350 °F.

3. Blower Motor Torque Data and Stall Amperage.

Full load torque ----- 2.4ft.-lb minimum
Locked rotor or stall torque ----- 5.3ft.-lb minimum
Breakdown torque ----- 7.5ft.-lb minimum
Pull up torque ----- 4.3ft.-lb minimum
Locked rotor or stall amperage ----- 45 amp

d. Time Standards. Table 1. lists the number of man-hours required under normal conditions for various operations in the maintenance and repair of the hot oil heater. The man-hours listed are not intended to be rigid standards. Under adverse conditions, the operation will take considerably longer; but under ideal conditions with highly skilled mechanics, most of the operations can be accomplished in considerably less time.

TABLE 1. TIME STANDARDS

LUBRICATION AND SERVICE

HOURS

55 PUMPS

5500 Pump Assembly

Pump, Circulating - wipe off pump and pump drain lines. 0.3

5513 Fluid Lines:

Hot Fluid Strainer (Clean strainers daily when used
and use alternately ----- 0.2

	HOURS
60 HEATING UNITS	
6004 Fuel System:	
Fuel, Oil Strainers (Clean daily and use alternately-----)	0.2
6005 Burner Assembly	
Air dampener cylinder (Oil can point every 100 hours, wipe before and after cleaning -----)	0.1
REMOVE AND REPLACE:	
06 ELECTRICAL SYSTEM	
0609 Lights: Clearance -----	0.6
0613 Hull or Chassis Wiring Harness	
Wiring Assembly-----	5.0
15 Frame	
1501 Frame Assembly:	
Cable Reel-----	0.3
Platform Assembly. (Remove blower, toolbox and control panels-----)	5.0
18 Hood and Hull	
1801 Hull Assemblies:	
Splash Guard-----	0.5
1808 Boxes;	
Container-----	0.5
22 Accessory Items	
2202 Accessory Items;	
Chock Blocks, Reflectors, Service Cables, Hose -----	0.5
2210 Data Plates	
Data Plate (COE)-----	0.5
Plate, Instruction-----	0.4
40 Electric Motors	
400 Major Assemblage: Motor Generator	
Motor pump (Disconnect wiring; removal guard and mounting bolts)-----	2.0
4001 Rotor Assemblies:	
Rotor-----	4.0
(same as motor pump)	
4002 Stator Assemblies:	
Stator (Same as motor pump)-----	4.0
4004 Ventilating System:	
Fan (Same as motor pump)-----	4.0
Frame Support and Housing:	
Frame (Same as motor pump)-----	10.0
4018 Junction Boxes	
Junction Boxes (Disconnect Conduits)-----	2.2
Bussbars (Same as Junction Boxes)-----	2.2

55 Pump

5500 Pump Assembly:

Pump Circulating (Remove mounting bolts, drain tank, remove guard, disconnect oil lines, loosen and slide motor back)-----	3.0
Pump Base Plate (Slide motor back, disconnect conduits, remove guard and pump)-----	3.5

5501 Shaft Drive:

Shaft (Same as pump removal)-----	6.0
Pumping, Rotors (Same as pump removal)-----	6.0

5502 Rings and Bearings

Rings; Bearings-----	6.0
----------------------	-----

5503 Lubricators;

Pump Drain Line-----	0.3
Cup-----	0.2

5511 Couplings:

Coupling, Drive (Slide motor back, loosen setscrew)-----	4.5
Guard-----	0.2

5513 Fluid Lines:

Piping Assemblies (Drain Tank)-----	4.5
Valves (Drain Tank)-----	0.2
Lines and Fittings-----	2.1
Strainer-----	2.0
Valve (three-way)-----	2.3

60 Heating Units

6001 Housing and Installation:

Hull, Heater (Remove complete burner housing and control panels)--	19.0
Vent Filler Piping-----	1.0
Plate, Rear; Viewer Assembly-----	0.8

6004 Fuel System:

Pump, Fuel (Remove case, lines and screws)-----	2.0
Strainer, Fuel-----	0.5
Lines and Fittings-----	0.5

6005 Burner Assembly:

Plate, Transformer (Remove U.V. Cell transformer, disconnect fuel lines)-----	5.0
Air Cone-----	5.0
Burner Head (Same as plate burner)-----	5.0
Blower (Disconnect leads)-----	1.5
Transformer, Igniter-----	1.0

Nozzles and Electrode (Same as transformer igniter)-----	5.5
Motor, Control-----	0.5
Butterfly-----	2.0
Coupling (same as butterfly)-----	1.5

6006 Motor Assembly:

Motor, Blower (Disconnect leads and remove blower)-----	1.5
---	-----

6010 Exhaust System

Stack, Exhaust-----	0.7
---------------------	-----

6011 Combustion Chamber:

Front End-----	6.0
----------------	-----

6013 Heat Exchanger Assembly -

Coil Heater (Remove hull end plate)-----	18.0
--	------

Section III. SPECIAL TOOLS AND EQUIPMENT

132. Special Tools and Equipment.

No special tools and equipment are required to perform direct and general support and depot maintenance on the hot oil heater.

133. Direct and General Support and Depot Maintenance Repair Parts.

Direct and general support and depot maintenance repair parts for the hot oil heater are listed and illustrated in this manual.

134. Specially Designed Tools and Equipment.

No specially designed tools and equipment are required to perform any maintenance requirements on the Hopkins Model 200 STM Hot Oil Heater.

Section IV. TROUBLESHOOTING

135. General.

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the hot oil heater or any of its components. Each trouble symptom stated is followed by a list of probable causes of the trouble. The possible remedy recommended is described opposite the probable cause.

136. TRANSFER OIL DOES NOT CIRCULATE PROPERLY.

<u>Probable Cause</u>	<u>Possible Remedy</u>
Supply valve, or pump valve defective.	Replace a defective gate valve. (Para. 176 through 178).
Circulating pump motor defective.	Repair a defective motor (Paras. 154 through 158).
Circulating pump defective.	Repair a defective pump. (Para. 172).
Clogged Strainer.	Clean Strainer (Para. 96 through 97).
Air or water trapped in oil.	Make sure all vents are open.

137. CIRCULATING PUMP MOTOR WILL NOT START

<u>Probable Cause</u>	<u>Possible Remedy</u>
Circulating pump motor starter defective.	Repair a defective motor starter. (Para. 152).
Circulating pump locked.	Repair a defective pump. (Para. 172)
Circulating pump motor defective.	Repair a defective pump motor. (Para. 154 through 158).

138. CIRCULATING PUMP MOTOR NOISY

<u>Probable Cause</u>	<u>Possible Remedy</u>
Circulating pump motor defective.	Repair a defective pump motor. (Paras. 154 through 158).
Circulating pump defective.	Repair a defective pump. (Para. 172).
Pump valve defective.	Replace a defective valve. (Paras. 176 through 178).

139. BLOWER MOTOR WILL NOT START

<u>Probable Cause</u>	<u>Possible Remedy</u>
Blower motor starter defective.	Repair a defective motor starter. (Para. 160).
Fuel pump locked.	Repair a defective fuel pump. (Para. 173).
Blower motor defective.	Repair a defective motor. (Paras. 162 through 166).

140. BLOWER MOTOR STARTER CIRCUIT BREAKER CONTINUES TO TRIP

<u>Probable Cause</u>	<u>Possible Remedy</u>
Blower motor defective.	Repair a defective blower motor. (Paras. 162 through 166).
Blower motor starter defective.	Repair a defective motor starter. (Para. 160).
Defective Temperature Controller.	Repair defective temperature controller. (Para. 168).
Ambient temperature above 125° F.	Open control box door and shade control box.

141. HOT OIL HEATER WILL NOT START

Probable Cause

Possible Remedy

Circulating pump motor starter defective

Repair a defective motor starter.
(Para. 152)

Blower motor starter defective.

Repair a defective motor starter.
(Para. 160)

Power supply not connected.

Connect power supply.

142. BURNER FAILS TO IGNITE.

Probable Cause

Possible Remedy

Burner electrodes defective.

Replace a defective electrode.
(Para. 182 through 184).

Burner nozzles defective

Replace a defective nozzle.
(Para. 182 through 184).

143. BURNER FLAME FAILURE.

Probable Cause

Possible Remedy

Burner electrodes defective.

Replace a defective electrode.
(Para. 182 through 184).

Burner nozzles defective.

Replace a defective nozzle.
(Para. 182 through 184).

Out of Fuel

Refill fuel supply tank if empty.

144. FUEL PUMP FAILS TO DELIVER ADEQUATE PRESSURE

Probable Cause

Possible Remedy

Blower motor defective.

Replace a defective blower motor.
(Para. 162 through 166)

Fuel pump defective.

Repair a defective fuel pump.
(Para. 174).

Fuel fittings drawing air.

Check and tighten fittings in
fuel line.

145. Not Used.

Section V. REMOVAL AND INSTALLATION OF THE CONTROL

BOX AND HEATER HULL

146. General.

The control box and heater hull are the major components of the hot oil heater. The control box must be disassembled before removal is possible. Complete disassembly is necessary before removal of the hull as a single unit, however, the entire hot oil heater, as a fully operable unit may be removed intact from the trailer for operation from suitable permanent base.

147. Control Box.

a. Removal.

WARNING: DO NOT PERFORM MAINTENANCE ON THE CONTROL BOX UNTIL THE EXTERNAL ELECTRICAL POWER SERVICE CABLE HAS BEEN REMOVED.

1. Remove the program controller. (Para. 79).
2. Tag and disconnect the wiring in the control box. (Para. 71).
3. Remove the burner, control power and circulating pump switch. (Para. 89).
4. Disconnect the U.V. Cell cable from the control box. (Para. 86)
5. Remove the blower motor starter. (Para. 77).
6. Remove the fuse block. (Para. 75).
7. Refer to Fig. 26 and remove the temperature control.
8. Refer to Fig. 27 and remove the circulating pump motor starter.
9. Refer to Fig. 27 and remove the control box from the angle frame supports.

b. Installation.

1. Position the control box for installation.
2. Refer to Fig. 37 and install the mounting nuts that secure the control box to the angle frame supports.
3. Install the fuse block. (Para. 75).
4. Install the blower motor starter. (Para. 77).
5. Refer to Fig. 27 and install the circulating pump motor starter.
6. Refer to Fig. 26 and install the temperature controller.
7. Install the emergency ON-OFF switch. (Para. 89).
8. Install the U.V. Cell cable into the control box. (Para. 86).
9. Connect the wiring in the control box. (Para. 71).
10. Install the program controller. (Para. 79).

148. Heater Hull.

WARNING: ALLOW FOR SUFFICIENT COOLING AFTER OPERATION BEFORE PERFORMING SERVICE OR MAINTENANCE ON THE HOT OIL HEATER AS SERIOUS INJURY FROM SECOND AND THIRD DEGREE BURNS COULD RESULT.

a. Removal.

1. Remove the vent pipe assembly. (Para.98).
2. Remove the hot fluid strainers. (Para.96).
3. Remove the three-way valves, lines and fittings. (Para.97).
4. Remove the relief valve, supply valve and the pump valve. (Para.176).
5. Remove the circulating pump base plate.(Para.95).
6. Remove the fuel oil strainers. (Para. 107).
7. Remove the liquid level sight gage. (Para.112).
8. Remove the low fluid level cutoff. (Para.84).
9. Remove the pressuretrol. (Para.83).
10. Remove the hot oil pressure gage. (Para.110).
11. Remove the hot oil temperature gage.(Para.111).
12. Remove the circulating pump motor starter.(Para. 82).
13. Remove the temperature control bulb in front pipe assembly.(Para.80).
14. Remove the burner plate. (Para.186).
15. Remove the exhaust stack. (Para.104).
16. Remove the rear plate and heater coil. (Para.188).
17. Refer to Fig. 49 and remove the heater hull.

b. Installation.

1. Refer to Fig. 49 and install the heater hull.
2. Install the heater coil and rear plate. (Para. 190).
3. Install the exhaust stack. (Para.104).
4. Install the burner plate. (Para.186).
5. Install the temperature control bulb in front pipe assembly. (Para.80).
6. Install the circulating pump motor starter. (Para. 82).
7. Install the hot oil temperature gage. (Para.111).
8. Install the hot oil pressure gage. (Para. 110).
9. Install the pressuretrol. (Para. 83).
10. Install the low fluid level cutoff. (Para.84).
11. Install the liquid level sight gage. (Para. 112).
12. Install the fuel oil strainers. (Para.107).
13. Install the circulating pump base plate. (Para.95).
14. Install the relief valve, supply gate valve, and pump valve.(Para.178).
15. Install the three-way valves, lines, and fittings. (Para.97).
16. Install the hot fluid strainers. (Para.96).
17. Install the vent pipe assembly.(Para.98).

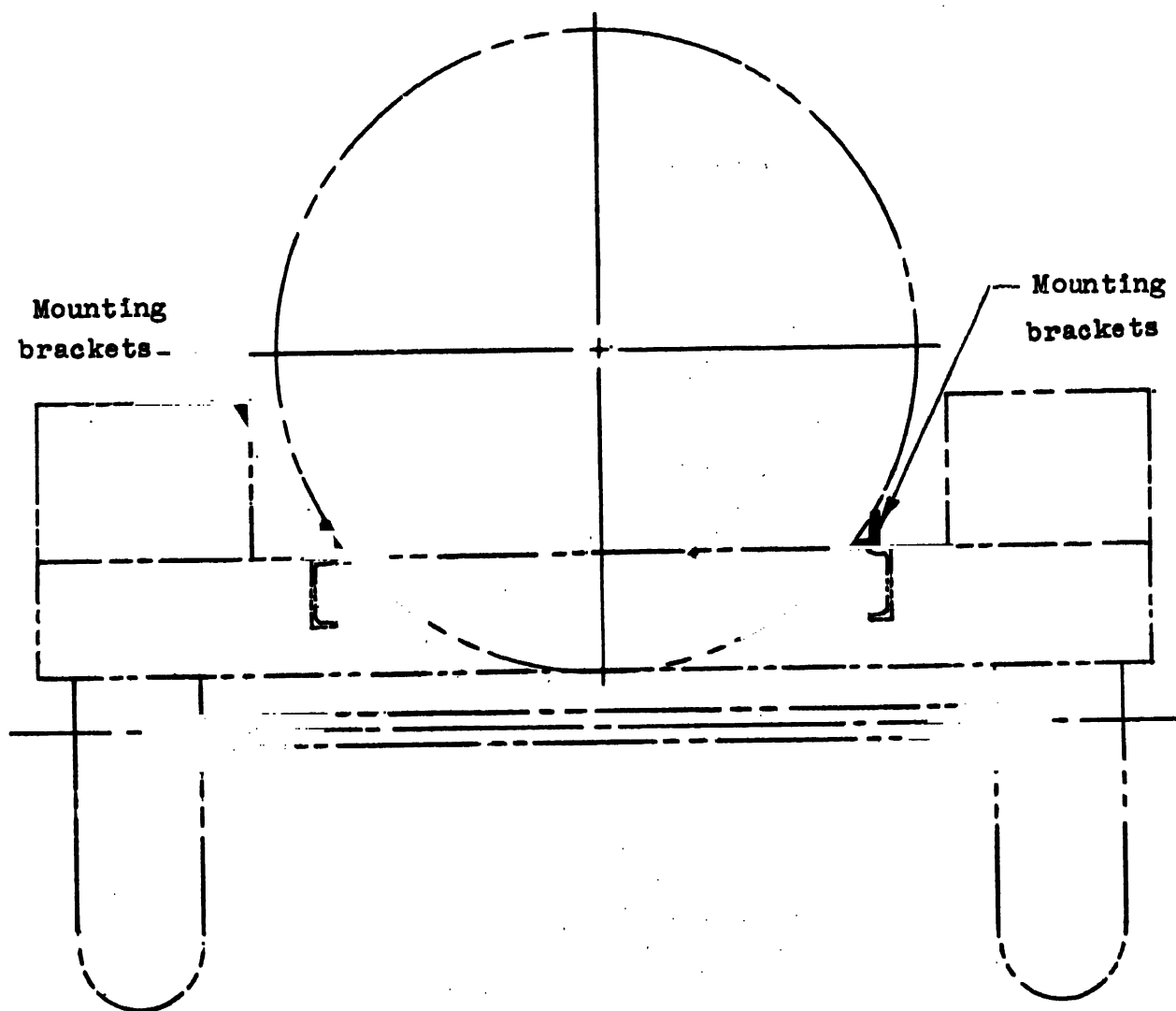


FIGURE 49. HEATER MOUNTING BRACKETS

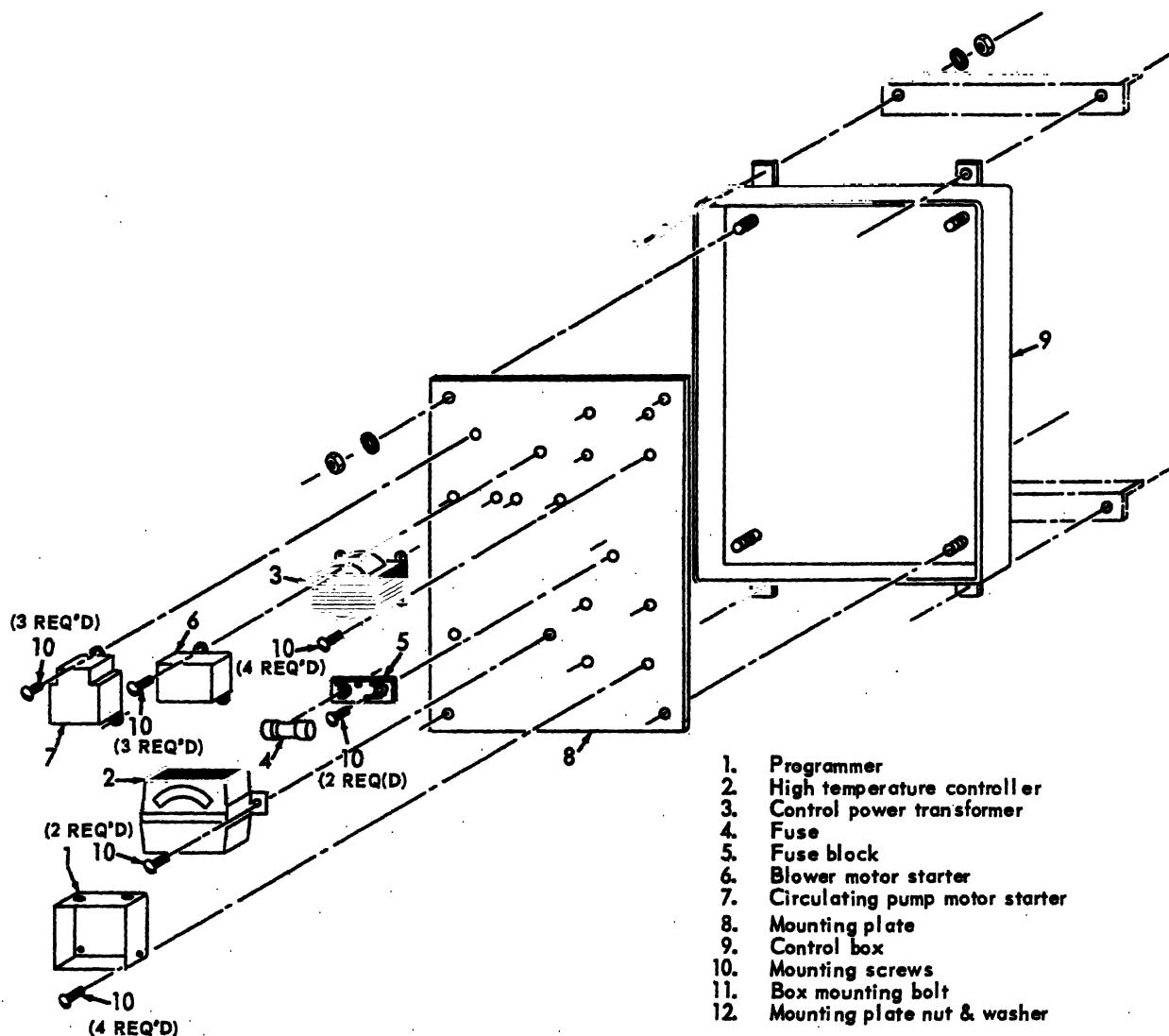


FIGURE 50. CONTROL BOX - DISASSEMBLY AND REASSEMBLY

Section VI. CONTROL BOX MAINTENANCE INSTRUCTIONS

149. General.

The control box, once its various components are removed, is a box housing with a hinged lid which can be closed and latched securely. The box housing, the hinged lid and latch, the terminal blocks, and the program controller terminal board are the basic parts of the control box assembly.

150. Control Box.

a. Removal and Disassembly.

1. Remove the control box. (Para. -147).
2. Refer to Fig. 50 and disassemble the control box.

Section V11. CIRCULATING PUMP MOTOR STARTER MAINTENANCE INSTRUCTIONS

151. General.

The circulating pump motor starter is a three switch magnetic starter used to activate the circulating pump motor and supply the electrical current to the other components of the burner electrical system.

152. Circulating Pump Motor Starter.

a. Removal and Disassembly.

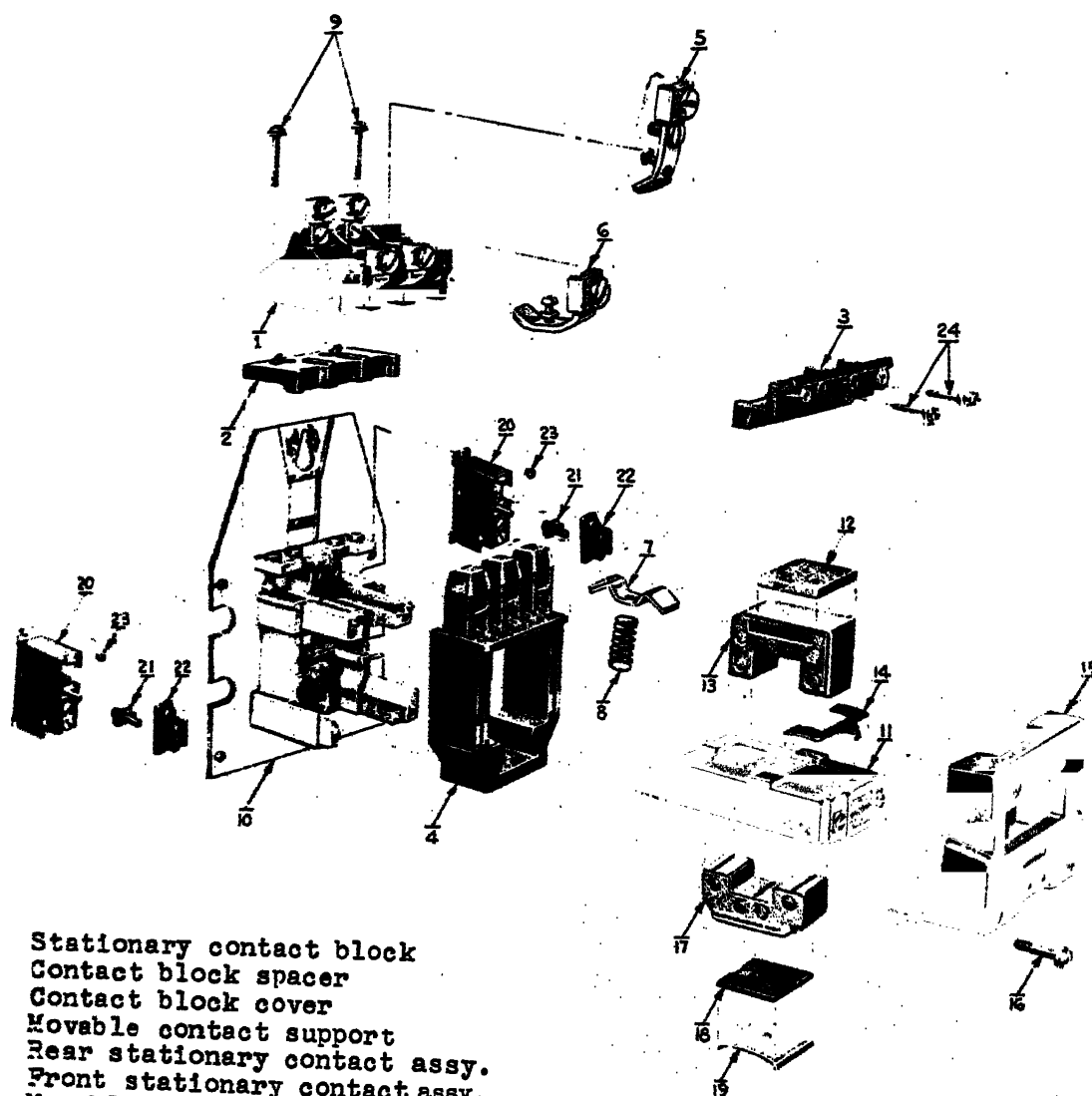
1. Remove the circulating pump motor starter. (Para 82).
2. Refer to Fig. 51 and disassemble the circulating pump motor starter.

b. Cleaning and Inspection, and Repair (Circ. Pump Motor Starter)

1. Clean all parts with an approved cleaning solvent and dry thoroughly.
2. Inspect all parts for cracks, breaks, defective threads, broken terminals, or other damage. Inspect for a defective reset switch.
3. Inspect for corrosion and signs of overheating. Replace all defective parts as necessary.

c. Reassembly and Installation.

1. Refer to Fig. 51 and reassemble the circulating pump motor starter.
2. Install the circulating pump motor starter. (Para.82).



1. Stationary contact block
2. Contact block spacer
3. Contact block cover
4. Movable contact support
5. Rear stationary contact assy.
6. Front stationary contact assy.
7. Movable contact
8. Contact spring
9. Contact block screws
10. Mounting plate & base assy.
11. Operating coil
12. Yoke retainer
13. Magnet yoke
14. Coil spring
15. Coil cover
16. Coil cover screws (4 req'd)
17. Magnet armature
18. Armature retainer
19. Retainer spring
20. Overload relay
21. Overload ratchet assy.
22. Heater element
23. Screw (2 req'd)
24. Contact block cover screws

FIGURE 51. CIRCULATING PUMP MOTOR STARTER DISASSEMBLY AND REASSEMBLY (SAME AS FIG. 27)

Section V111. CIRCULATING PUMP MOTOR MAINTENANCE INSTRUCTIONS

153. General.

The circulating pump motor is a 3-phase, 4-wire electric motor used to drive the circulating pump through a flexible coupling. The motor has an impeller fan and a vaned rotor for ventilation.

154. Removal and Disassembly.

- a. Removal. Remove the circulating pump motor. (Para.92)
- b. Disassembly. Refer to Fig. 52 and disassemble the circulating pump motor.

155. Testing After Disassembly.

- a. Test the stator for a short as instructed in TM 5-764.
- b. Test for an open circuit and insulation resistance.

156. Cleaning, Inspection, and Repair.

- a. Clean all parts with a cloth dampened in an approved cleaning solvent and dry thoroughly.
- b. Inspect the bearings for freedom of action and any defects. Replace a defective bearing.
- c. Inspect all parts for cracks, breaks, or other damage. Replace as necessary.
- d. Inspect the impeller fan and rotor for broken fins, signs of wear and other damage. Replace a defective impeller fan or rotor.
- e. Inspect the stator for defective insulation, signs of overheating and other damage. Rebuild a defective stator.

157. Circulating Pump Motor Rebuild.

Refer to TM 5-764 and direct and general support and depot tabulated data (Para. 131). and rebuild the circulating pump motor stator.

158. Reassembly and Installation.

- a. Reassembly. Refer to Fig. 52 and assemble the circulating pump motor.
- b. Installation. Install the circulating pump motor. (Para.92).

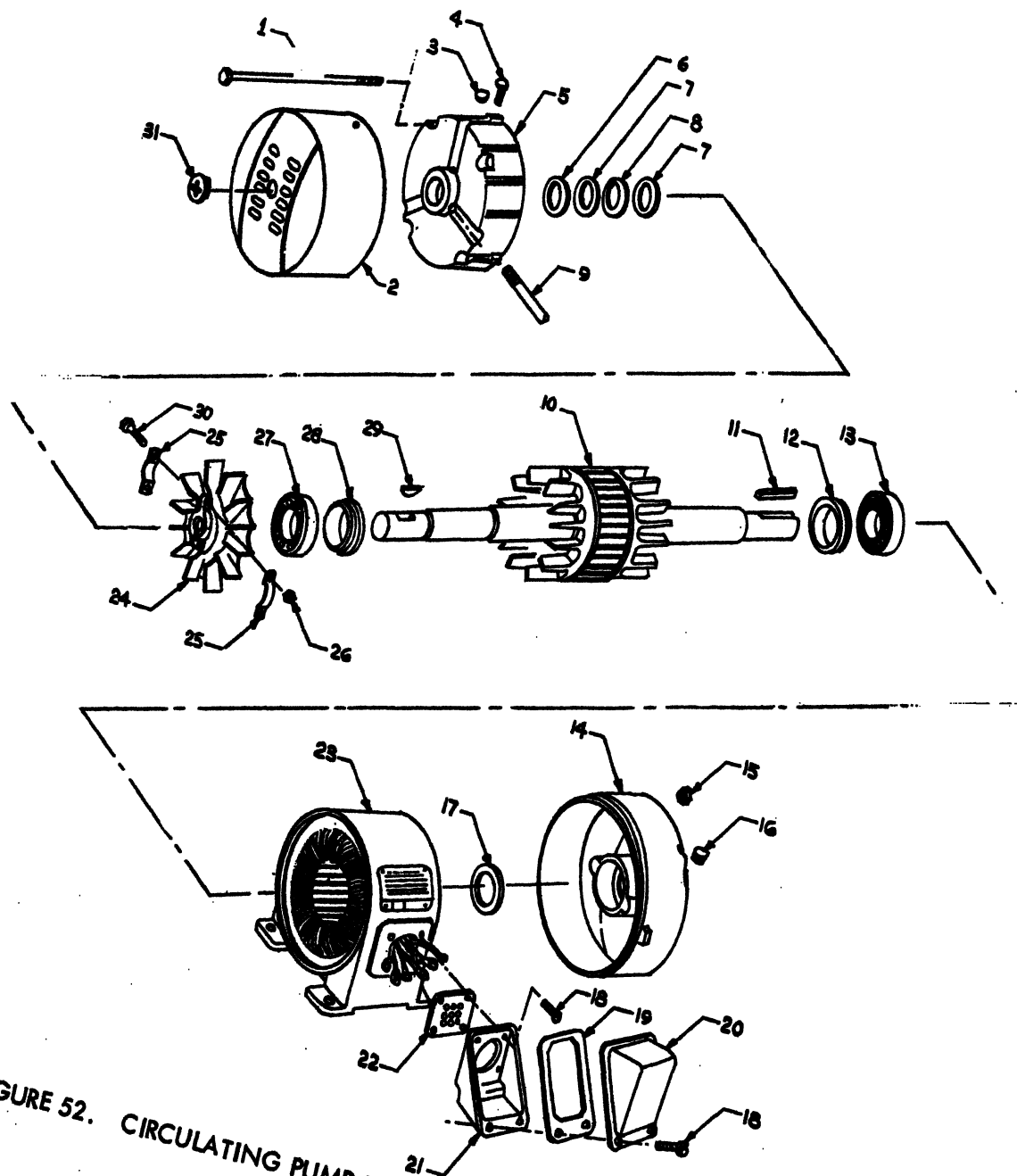


FIGURE 52. CIRCULATING PUMP MOTOR ASSEMBLY AND DISASSEMBLY

LEGEND FOR FIGURE 52

- | | | |
|------------------------|--------------------------|----------------------|
| 1. THROUGH BOLT | 10. ROTOR | 19. GASKET |
| 2. FAN COVER | 11. KEY | 20. COVER |
| 3. PIPE PLUG | 12. SLINGER | 21. JUNCTION BOX |
| 4. SCREW, CAP, HEX HD. | 13. BEARING | 22. CONNECTOR SOCKET |
| 5. END BELL | 14. END BELL | 23. STATOR |
| 6. SHIM WASHER | 15. NUT HEX | 24. FAN |
| 7. SPRING WASHER | 16. PIPE PLUG | 25. BRACKET |
| 8. SPACER | 17. SHIM WASHER | 26. NUT |
| 9. PIPE PLUG | 18. SCREW, MACH. RD. HD. | 27. BEARING |
| | | 28. SLINGER |
| | | 29. WOODRUFF KEY |
| | | 30. SCREW |
| | | 31. DUST COVER |

Section 1X. BLOWER MOTOR STARTER MAINTENANCE INSTRUCTIONS.

159. General.

The blower motor starter is a magnetic starter with a fast tripping circuit breaker and a reset bar. It is equipped with two safety heaters which are replaceable without removing the blower motor starter.

Legend for Fig. 53.

1. Mounting plate
2. Movable contact support less contacts
3. Stationary contact block complete w/contacts
4. Contact block screw
5. Movable contact
6. Yoke assembly
7. Contact spring
8. Connector
9. Armature assembly
10. Coil screw assembly
11. Operating coil (not shown)
12. Overload relay
13. Heater element
14. Screw (2 req'd)
15. Overload ratchet assembly

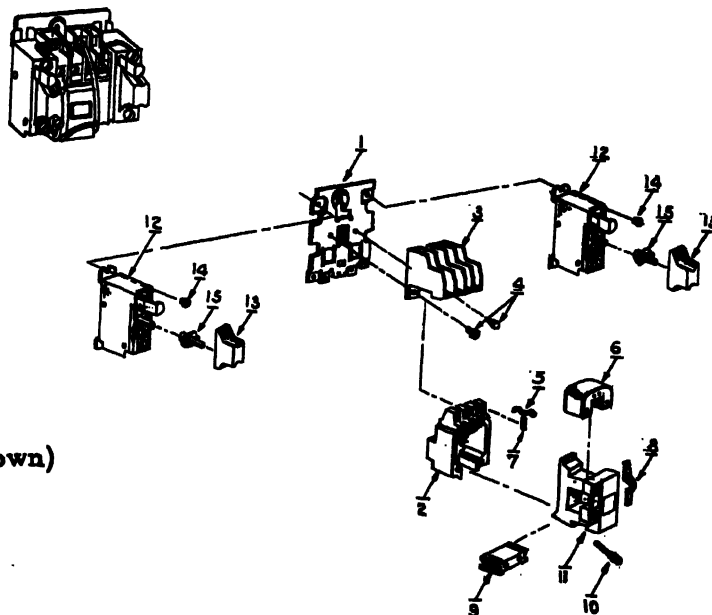


FIGURE 53. BLOWER STARTER ASSEMBLY AND DISASSEMBLY

160. Blower Motor Starter.

a. Removal and Disassembly.

1. Remove the blower motor starter. (Para. 77).
2. Refer to Fig. 53 and disassemble the blower motor starter.

b. Cleaning, Inspection, and Repair.

1. Clean all parts with an approved cleaning solvent and dry thoroughly.
2. Inspect all parts for cracks, breaks, damaged threads, broken terminals or other damage. Replace damaged parts.
3. Inspect for a defective reset switch.
4. Inspect for corrosion or signs of overheating. Replace all defective parts as necessary.

c. Reassembly and Installation. Blower Motor Starter.

1. Refer to Fig. 53 and reassemble the blower motor starter.
2. Install the blower motor starter. (Para. 77).

Section X. BLOWER MOTOR MAINTENANCE INSTRUCTIONS

161. General.

The blower motor is a 3-phase induction motor used to drive both the blower fan and the fuel pump. It is cooled by an internal impeller type fan which draws air through the end bell and exhausts through ports in the base of the motor.

162. Removal and Disassembly.

- a. Removal. Refer to Para. 91 and remove the blower motor.
- b. Disassembly. Refer to Fig. 54 and disassemble the blower motor.

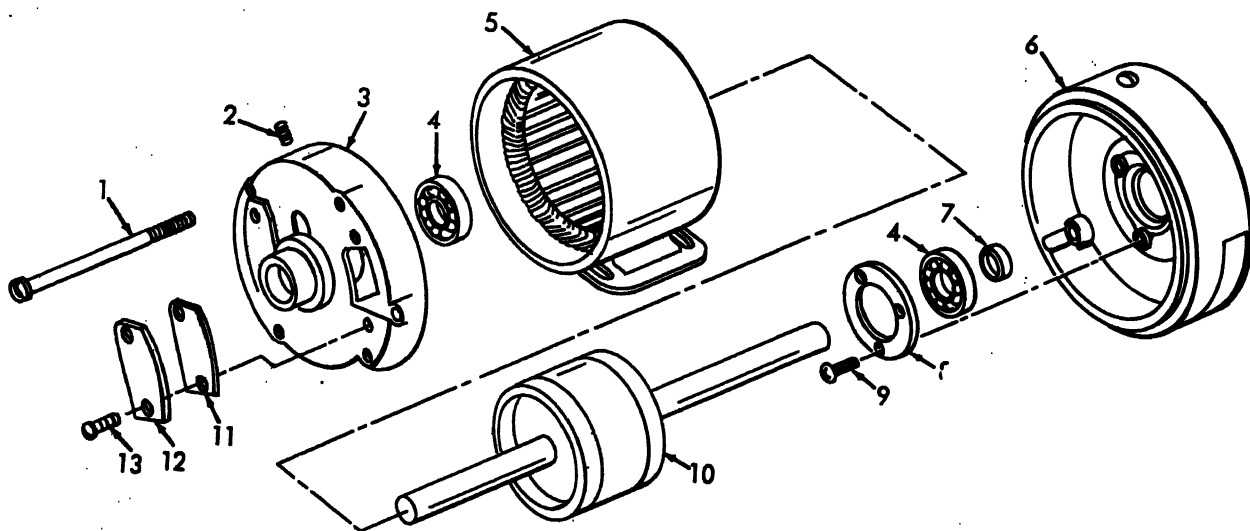


FIGURE 54. BLOWER MOTOR ASSEMBLY AND DISASSEMBLY

1. THROUGH BOLT
2. GREASE PLUG
3. END BELL
4. BEARING
5. STATOR
6. END BELL
7. LOCKING COLLAR
8. BEARING CAP
9. SCREW, CAP
10. ROTOR
11. GASKET
12. TERM. COVER
13. SCREW, MACH.

- b. Inspect the bearings for freedom of action and any defects. Replace a defective bearing.
- c. Inspect all parts for cracks, breaks, and other damage. Replace defective parts as necessary.
- d. Inspect the rotor for signs of wear and other damage. Replace a defective rotor.
- e. Inspect the stator for defective insulation, signs of overheating and other damage. Replace or rebuild a defective stator.

165. Blower Motor Stator Rebuild .

Refer to TM 5-764 and direct and general support and depot maintenance tabulated data (Para. 131) and rebuild the blower motor stator.

166. Reassembly and Installation.

- a. Reassembly. Refer to Fig. 54 and reassemble the blower motor.
- b. Installation. Install the blower motor. (Para.91).

Section X1. TEMPERATURE CONTROLLER MAINTENANCE INSTRUCTIONS

167. General .

The temperature controller is a variable limit switch used to set the heat requirements on the hot oil heater. In principal, it is partially mechanical and partly pneumatic. The capillary tube and bulb which is the heat sensing element of the unit is inserted in the main flow of heat transfer oil and able to give continuous temperature information to the indicator and control mechanism at all times during the operation of the hot oil heater. The temperature controller is equipped with a control knob which sets the maximum heat limits for operation. The burner turns on at approximately 25° F. below the maximum setting.

168. Temperature Controller.

a. Removal and Disassembly.

- 1. Remove the temperature controller. (Para.80).
- 2. Refer to Fig. 55 and disassemble the temperature controller.

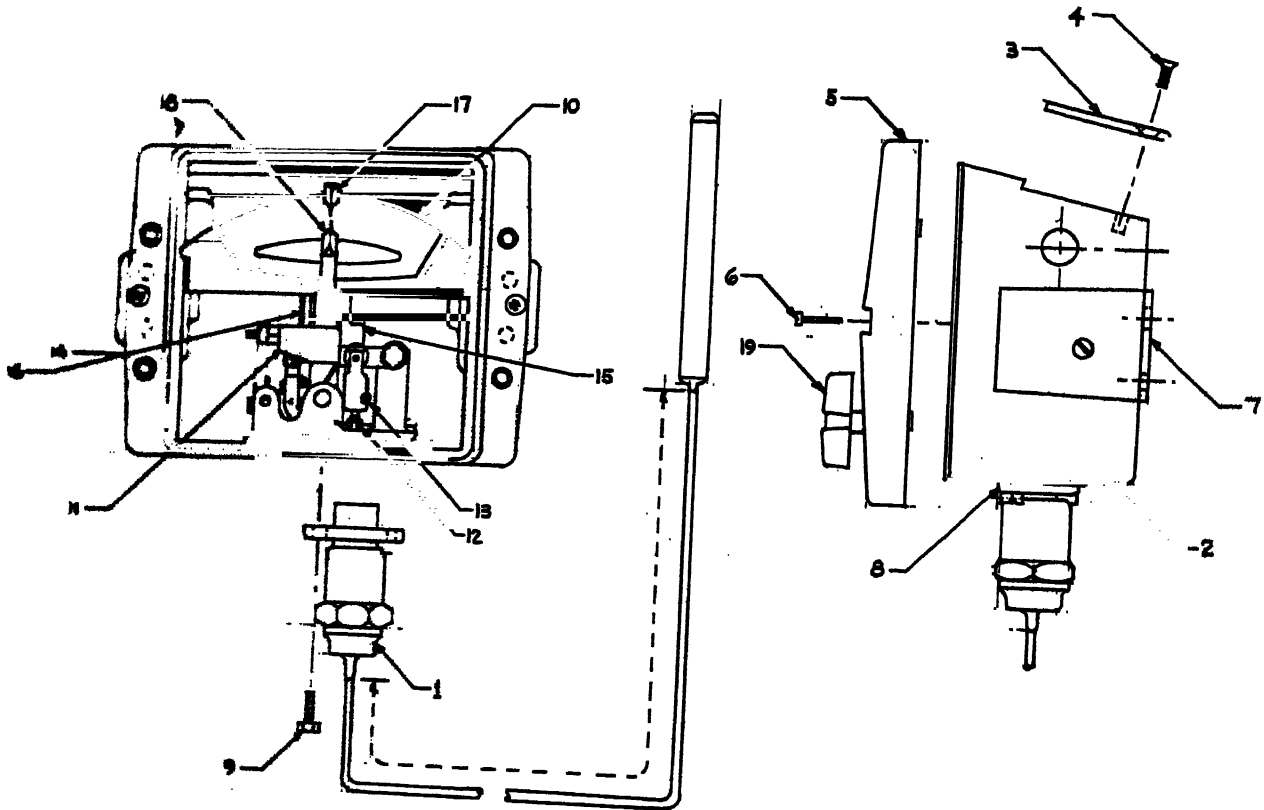
b. Cleaning, Inspection, and Repair.

- 1. Clean all parts except gaskets with an approved cleaning solvent and dry thoroughly.
- 2. Inspect for cracks, breaks, cracked or broken cover glass, bent indicating hands, and other damage.
- 3. Inspect the capillary tube and bulb for restrictive bends and other damage.

4. Inspect the mounting hardware for cracks, breaks and damaged threads.
Replace a defective part.

c. Reassembly and Installation.

1. Refer to Fig. 55 and reassemble the temperature controller.
2. Install the temperature controller. (Para. 80).



PARTS LIST					
1	THERMAL ELEMENT		WASHER	12	PUSHROD
2	CASE		SCREW	13	SET SCREW
3	TOP PLATE	6	COVER SCREW	14	CONTROL SWITCH
4	TOP R SCREW	7	MOUNTING ANGLE	15	SWITCH INSULATOR
5	COVER ASSEMBLY	8	ELEMENT FLANGE	16	SWITCH HOLDING SCR.
	COVER	9	FLANGE SCREW	17	SETTING POINTER TIP
	GASKET	10	DIAL	18	INDICATING POINTER TIP
	GLASS	11	MECHANISM ASSEMBLY	19	SETTING KNOB

• COMPLETE WITH TERMINAL BLOCK SWITCH AND

* COMPLETE WITH TERMINAL BLOCK, SWITCH AND WIRES

FIGURE 55. TEMPERATURE CONTROL ASSEMBLY AND DISASSEMBLY

Section X11.

LOW FLUID LEVEL CUTOFF MAINTENANCE INSTRUCTIONS

169. General.

The low fluid level cutoff uses the float level principal of operation. A magnetic mercury switch is activated by the float rod when the level in the hot oil heater's surge tank, reservoir and expansion tank drops below safe operating level and shuts down the hot oil heater.

170. Low Fluid Level Cutoff.

a. Removal and Disassembly.

1. Remove the low fluid level cutoff. (Para. 84).
2. Refer to Fig. 56 and disassemble the low fluid level cut off.

b. Cleaning, Inspection and Repair.

1. Clean all parts, except gasket, with an approved cleaning solvent and dry thoroughly.
2. Inspect for cracks, breaks, frayed insulation, and cracked, or broken mercury switch.
3. Inspect the float and rod for condition and operation.
4. Inspect the hardware for cracks, breaks, and damaged threads. Replace a defective part.

c. Reassembly and Installation.

1. Refer to Fig. 56 and reassemble the low fluid level cutoff.
2. Install the low fluid level cutoff. (Para.84).

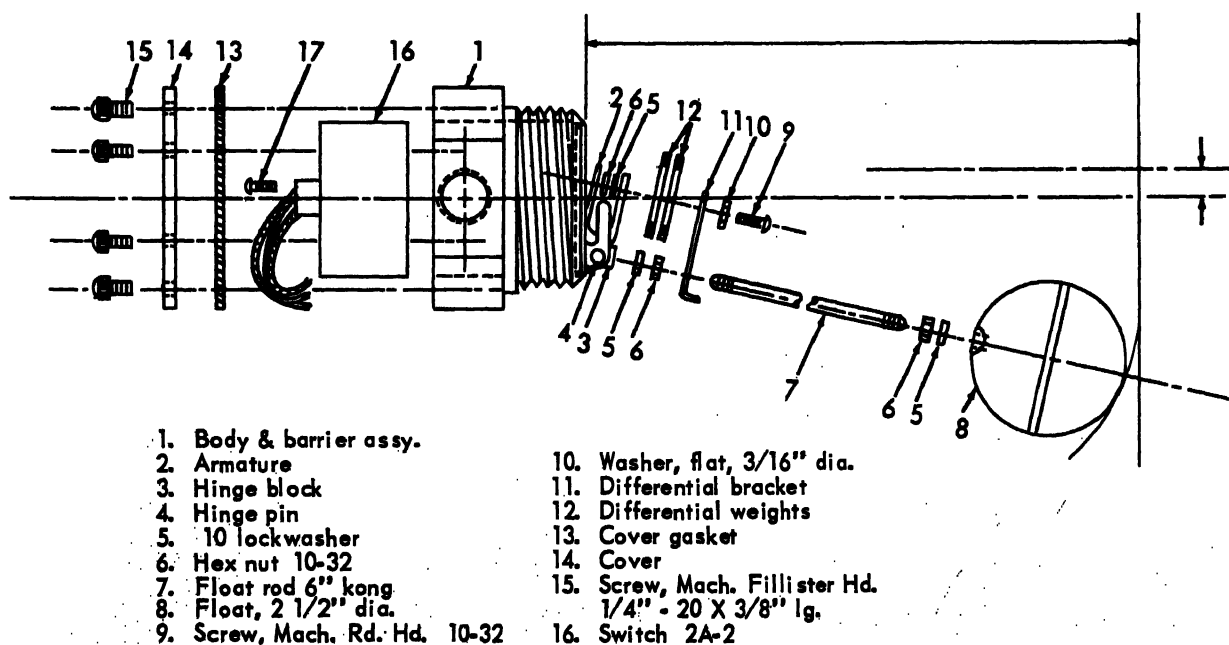


FIGURE 56. LOW LEVEL ASSEMBLY AND DISASSEMBLY

Section X111. CIRCULATING PUMP MAINTENANCE INSTRUCTIONS

171. General.

The circulating pump is of the positive displacement type with internal type lubrication. The pump shaft is supported by a radial and thrust bearing and the pump has external packing adjustment points and openings for pump priming.

172. Circulating Pump.

a. Removal and Disassembly.

1. Remove the circulating pump. (Para.94).
2. Refer to Fig. 57 and disassemble the circulating pump.

b. Cleaning, Inspection, and Repair.

1. Clean all parts with an approved cleaning solvent and dry thoroughly.
2. Inspect the shaft and bearings for signs of wear and damage.
3. Inspect all parts for cracks, dents and distortion. Inspect for damaged threads.
4. Inspect the mating surfaces between pump and piping. Make sure a good clean contact of mating surfaces can be established upon installation.
5. Replace a defective part.

c. Reassembly and Installation.

1. Refer to Fig. 57 and reassemble the circulating pump.
2. Install the circulating pump.(Para.94).

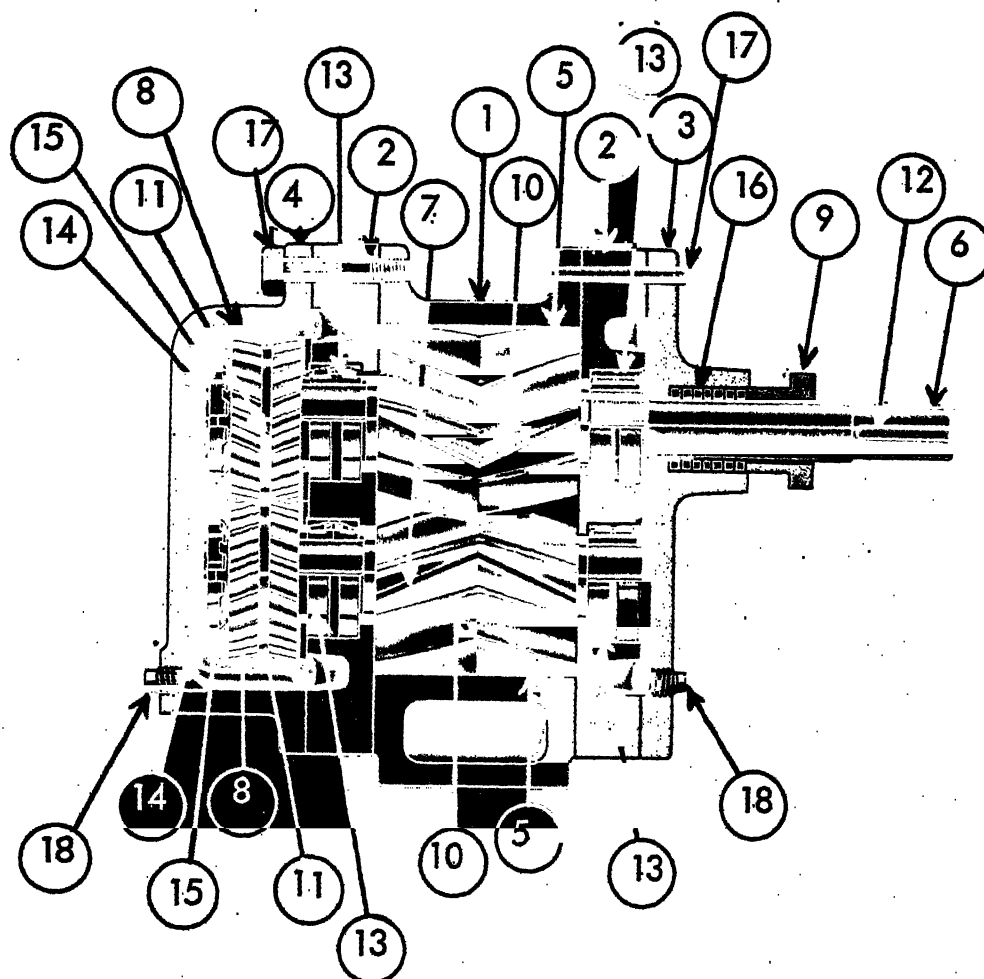


FIGURE 57. CIRCULATING PUMP ASSEMBLY AND DISASSEMBLY

LEGEND FOR FIGURE 57

LIST OF MATERIAL

- | | | |
|-----------------------|----------------------|------------------------------|
| 1. BODY | 9. GLANDS | 17. COVER BOLTS |
| 2. BEARING BRACKETS | 10. ROTOR KEYS | 18. OIL DRAIN PLUGS |
| 3. FRONT COVER | 11. TIMING GEAR KEYS | 19. GLAND STUDS (NOT SHOWN) |
| 4. REAR COVER | 12. COUPLING KEY | 20. GLAND NUTS (NOT SHOWN) |
| 5. ROTORS-HERRINGBONE | 13. ROLLER BEARINGS | 21. ROTOR SPACER (NOT SHOWN) |
| 6. DRIVE SHAFT | 14. LOCK NUTS | |
| 7. DRIVEN SHAFT | 15. LOCK WASHERS | |
| 8. TIMING GEARS | 16. GLAND PACKING | |

Section XIV. FUEL PUMP MAINTENANCE INSTRUCTIONS.

173. General.

The fuel pump is a two-stage, self purging fuel oil pump. It operates on the centrifugal principal and has a noise eliminator built in. It is mounted during operation to a common shaft with a blower fan and blower motor.

174. Fuel Pump.

a. Removal and Disassembly.

1. Remove the fuel pump. (Para. 106).
2. Refer to Fig. 58 and disassemble the fuel pump.

b. Cleaning, Inspection and Repair.

1. Clean all parts with the exception of the antihum wafer, in an approved cleaning solvent and dry thoroughly.
2. Discard the antihum wafer.
3. Inspect the pump for cracks, breaks, signs of wear, and damaged threads, and fittings.
4. Inspect the mounting hardware for cracks, breaks, and damaged threads.
5. Replace a defective part. Install a new antihum wafer.

c. Reassembly and Installation.

1. Refer to Fig. 58 and reassemble the fuel pump.
2. Install the fuel pump. (Para. 106).

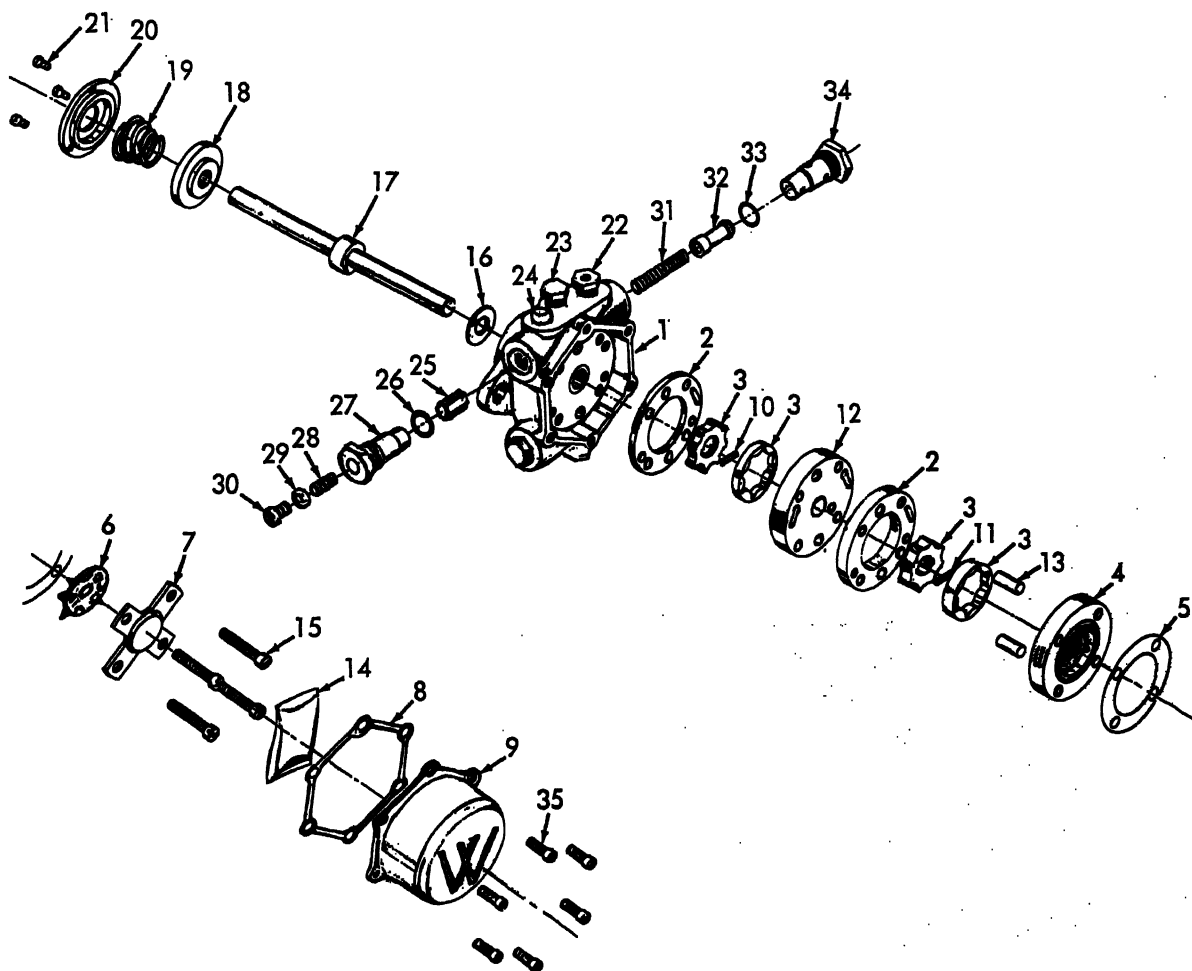


FIGURE 58. Fuel Pump, disassembly

- | | |
|---|--|
| 1. Body 29521-78 | 19. Seal spring 32672 all units |
| 2. Gear plate 19859-3 3/16" | 20. Seal retainer 27917 all units |
| 3. Inner & Outer gears 2681-5 3/16" | 21. Seal ret. screw 29526-19 all units |
| 4. Gear cover plate 19858-2 | 22. Vent plug A37Q6 |
| 5. Cleaner spacer 19867 | 23. Four 1/4" pipe plugs all units (never removed) |
| 6. Cleaner blade 25086 | 24. Flush plug 37232 all units (never removed) |
| 7. Cleaner cover 19868-1 | 25. Spring cap 19878-4 |
| 8. Front cover gasket 19871 | 26. Valve gasket 21204 |
| 9. Front cover 20141 | 27. Pressure adj. screw plug 21192 |
| 10. Drive pin 21512 | 28. Pressure adj. screw 29543-2 all units |
| 11. Drive key 21417 | 29. V. cover screw gasket 24177 all units |
| 12. Intermediate plate 21507-2 | 30. Valve cover screw P36Q2 all units |
| 13. Dowel pin 20149 | 31. Valve spring 19877 |
| 14. Sound cushion 35548 | 32. Piston assembly 25121 |
| 15. Screw 29521-49 | 33. Valve gasket 21204 |
| 16. Thrust washer 21196-2 | 34. Plug & guide assembly 25122-3 |
| 17. Drive shaft assembly 27942-4 standard 3-5/16" | 35. Front cover screw 29521-52 |
| 18. Seal diaphragm assy. 13966 all units | |

FIGURE 58. FUEL PUMP ASSEMBLY AND DISASSEMBLY



FIGURE 59. REMOVAL AND ASSEMBLY OF HOT OIL RELIEF SUPPLY PUMP AND FILL VALVES

Section XV. RELIEF VALVE, FRONT PIPE ASSEMBLY, GATE VALVE,
AND FEED LINE GATE VALVE, MAINTENANCE INSTRUCTIONS

175. General.

The front pipe assembly, supply valve, and fill valve are nearly identical in appearance, construction, and operation. The removal, repair, and installation of these two valves is accomplished in a similar manner. The relief valve is of the solid piston type with an inlet in the bottom and discharge on the side.

176. Removal and Disassembly.

a. Removal. Refer to Fig. 59 and remove the relief valve, the supply valve, and the fill valve.

b. Disassembly. Refer to Fig. 60 and disassemble the relief valve, supply valve, and fill valve.

177. Cleaning, Inspection and Repair.

a. Clean all parts in an approved cleaning solvent and dry thoroughly.

b. Inspect for cracks, breaks, a bent stem, cracked or broken bonnet, damaged threads, and other damage.

c. Inspect for signs of wear. Replace a defective part.

NOTE: IF THE HOUSING OR WEDGE IS DEFECTIVE, THE ENTIRE VALVE MUST BE REPLACED, SINCE THESE TWO PARTS ARE MATED FOR MAXIMUM VALVE EFFICIENCY.

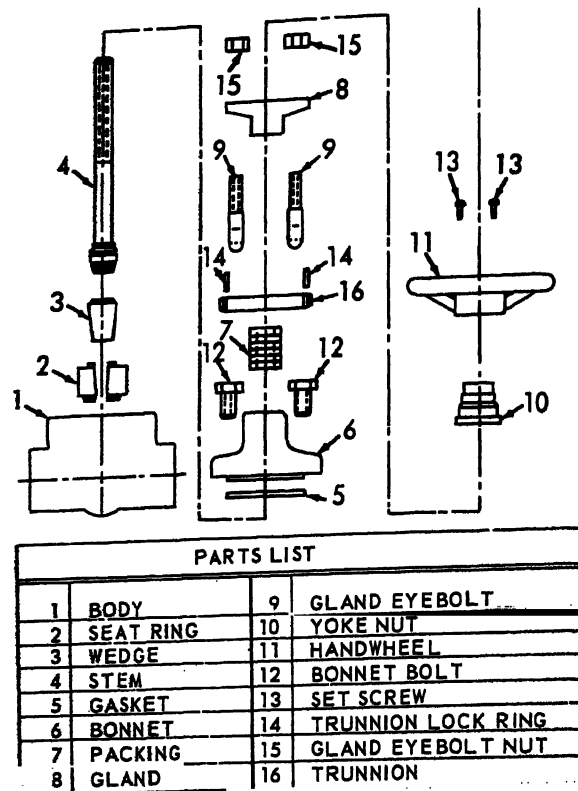


FIGURE 60A. GATE VALVE ASSEMBLY AND DISASSEMBLY

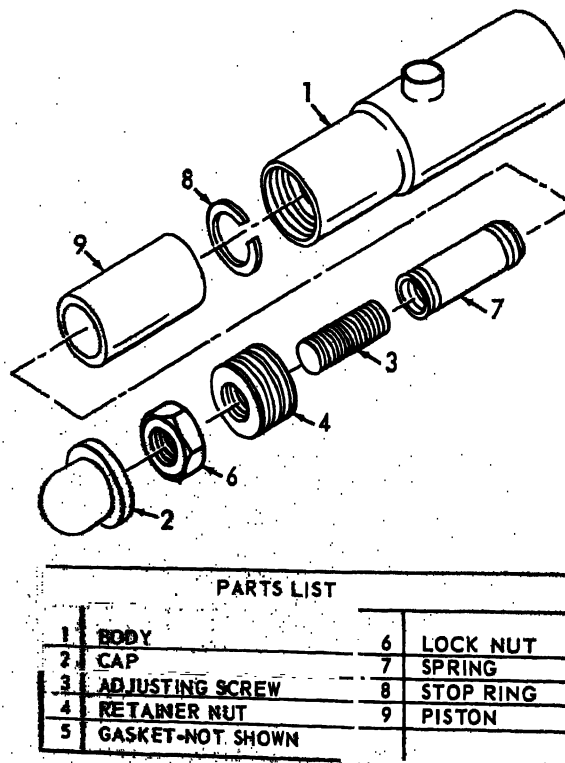
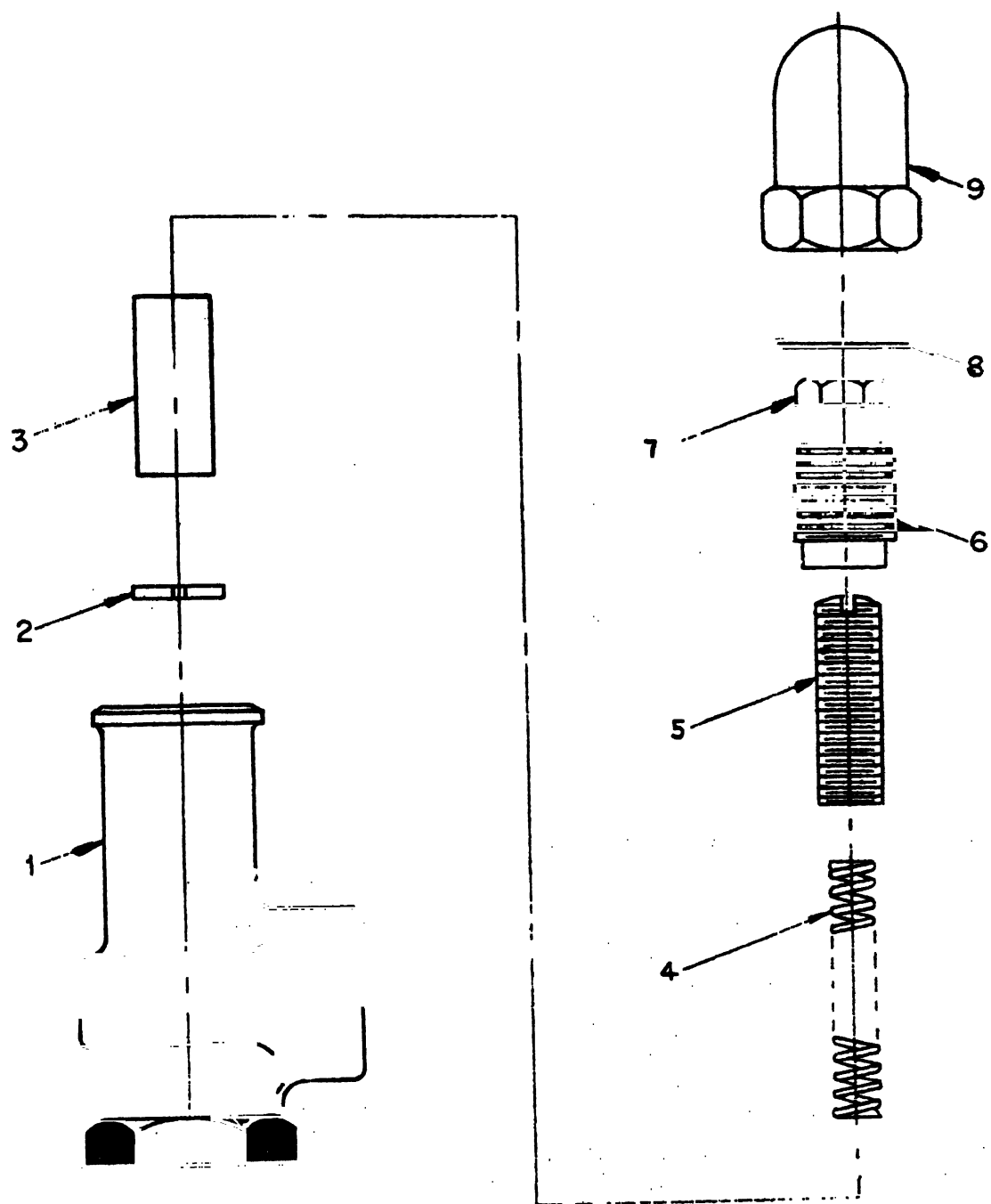


FIGURE 60. RELIEF VALVE ASSEMBLY AND DISASSEMBLY.



PARTS LIST

1	BODY	6	RETAINER NUT
2	STOP RING	7	LOCK NUT
3	PISTON	8	GASKET
4	SPRING	9	CAP
5	ADJUSTING SCREW		

FIGURE 60B. RELIEF VALVE ASSEMBLY AND DISASSEMBLY

Section XV1. BURNER END PLATES MAINTENANCE INSTRUCTIONS

179. General.

The burner end plates are integral with the blower housing and provide a means of connecting the blower to the hot oil heater front end plate. They can only be removed with the blower and it would be useless to describe their removal for this reason. They should be inspected periodically as follows:

180. Cleaning and Inspection.

1. Clean all parts, excluding the gaskets, with an approved cleaning solvent and dry thoroughly.
2. Inspect for cracks, breaks, signs of gasket leakage, and other damage.
3. Inspect the mounting hardware for cracks, breaks, and damaged threads.
4. Replace all defective parts as may be necessary.

Section XV11. DRAWER ASSEMBLY, AIR CONE, NOZZLES, AND ELECTRODES, MAINTENANCE INSTRUCTIONS

181. General.

The drawer assembly is the assembly which combines the air, fuel and ignition to provide the fire power for the hot oil heater. Three fuel nozzles and two electrodes mix the fuel and ignite it. The high volume of air from the blower motor projects the flame into the combustion chamber to heat the transfer oil in the heater coil which surrounds it.

182. Removal and Disassembly.

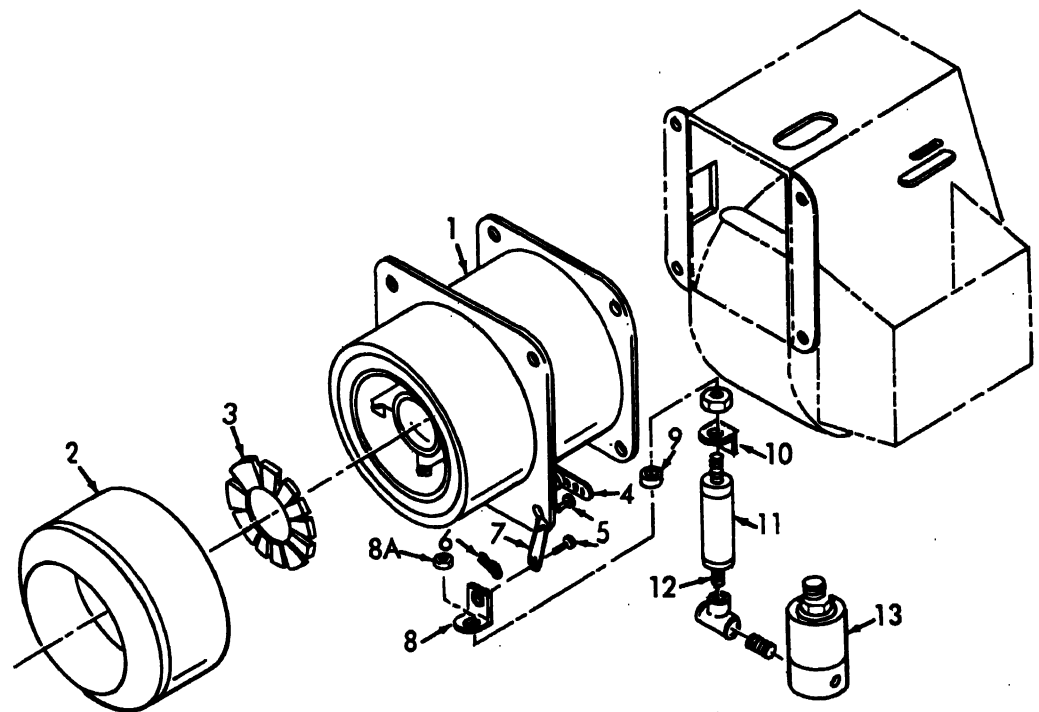
- a. Remove the drawer assembly. (Fig. 40).
- b. Remove the burner head. (Para. 102).
- c. Refer to Fig. 61 and disassemble the burner head, air cone, nozzles, and electrodes.

183. Cleaning, Inspection and Repair.

- a. Clean all parts in an approved cleaning solvent and dry throughout.
- b. Remove any carbon deposits from the electrodes and nozzles. Nozzle apertures and air and fuel passages should be clear of obstruction.
- c. Inspect all parts for cracks, breaks and other damage.
- d. Inspect the ceramic portions of the electrodes for cracks, breaks and loose mounting.
- e. Inspect the hardware for cracks, breaks, and damaged threads.
- f. Inspect the air cone collar for distortion, and other damage. Air cone collar should fit tightly on air cone when installed and slot should be aligned with proper air cone slot.
- g. Replace any defective parts as may be necessary.

184. Reassembly and Installation.

- a. Refer to Fig. 61 and reassemble the burner head, air cone, nozzles and electrodes.
- b. Adjust the burner electrodes. (Para.103).
- c. Install the burner head. (Para.102).



- | | |
|--------------------|---------------------------|
| 1. Blast tubes | 8. Adapter bracket |
| 2. Retention ring | 8A Adapter bracket nut |
| 3. Spinner | 9. Stroke adjust collar |
| 4. Damper arm | 10. Mounting bracket |
| 5. Pin | 11. Oil cylinder |
| 6. Fastening clip | 12. Orifice, oil cylinder |
| 7. Connecting link | 13. 3-way valve |

FIGURE 61A. BURNER ASSEMBLY, REMOVAL, DISASSEMBLY, REASSEMBLY, AND INSTALLATION

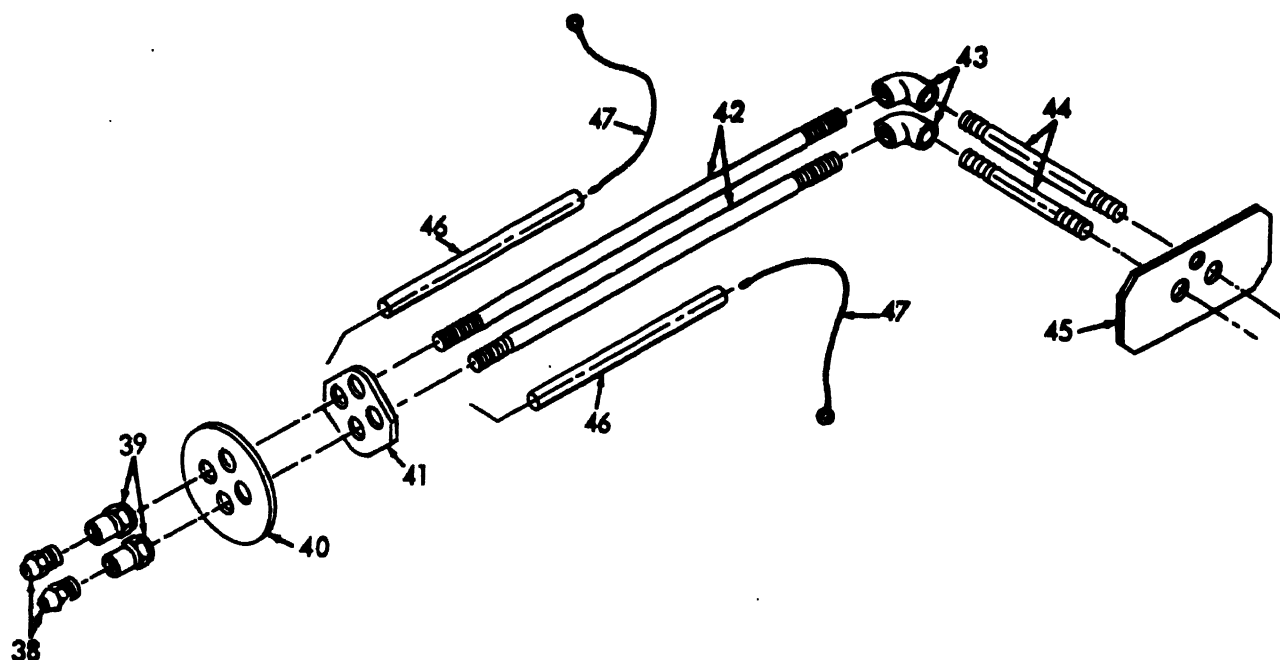
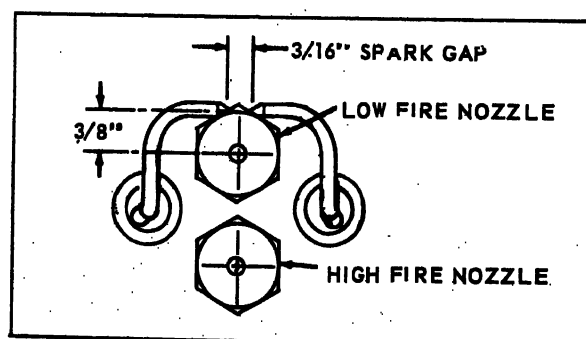


FIGURE 61B. ELECTRODE ADJUSTMENT AND DETAIL ASSEMBLY

- 38. Oil nozzles
- 39. Oil nozzle adapter
- 40. Static disc
- 41. Electrode support
- 42. Brass nipple
- 43. Elbow, brass nipple
- 44. Brass nipple
- 45. Adjustment plate, oil assy.
- 46. Ignition electrodes & porcelain insulator
- 47. Ignition cable



Section XVIII. REAR PLATE AND HEATER COIL MAINTENANCE INSTRUCTIONS

185. General.

The rear plate covers the rear aperture of the combustion chamber which contains, principally, the heater coil and the refractory lining. The coil is helical in design and is used to circulate the transfer oil around the burner flame a sufficient number of times to allow it to reach the required temperature.

186. Removal.

- a. Remove the rear plate viewer assembly. (Para.100).

187. Cleaning and Inspection.

- a. Clean all parts with an approved cleaning solvent and dry thoroughly.
- b. Inspect the rear plate and heater coil for cracks, breaks, signs of heat transfer oil leakage in the heater coil, and other damage.
- c. Inspect mounting nuts and studs for cracks, breaks and damaged threads. Replace a defective part.

188. Installation.

- a. Refer to Fig. 62 and install the heater coil and rear plate.
- b. Install the rear plate viewer assembly. (Para.100).

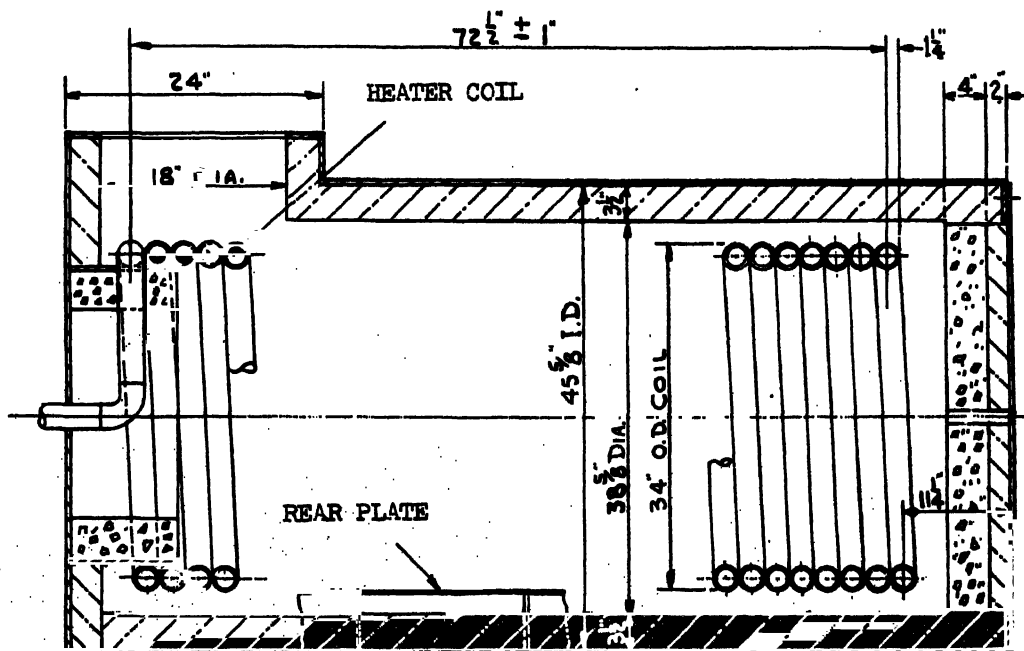


FIGURE 62. INTERNAL ASSEMBLY OF HEATER

Section **XIX.** HULL PIPING, AND REFRACTORY MAINTENANCE
INSTRUCTIONS.

189. General.

When all components have been removed from the heater hull, only three item categories remain in the hull assembly: the piping, refractory assembly, and the hull itself. It is not recommended that either the piping or refractory be removed from the hull except if defective or a modification is intended. All the piping is welded and the refractory, once it has been flame-proofed, will crumble easily.

190. Removal.

- a. Remove the heater hull. (Para. 148).
- b. Refer to Fig. 63 and remove the piping and refractory.

191. Cleaning, Inspection, and Repair.

- a. Clean all parts, with the exception of the refractory, with an approved cleaning solvent and dry thoroughly.
- b. Inspect the heater hull and piping for cracks, breaks, rust and other damage
- c. Inspect the hull mounting hardware for cracks, breaks and damaged threads. Inspect for defective refractory.
- d. Replace a defective part. Replace any defective refractory.

192. Installation.

- a. Refer to Fig. 63 and install the refractory and piping.
- b. Install the heater hull. (Para. 148).

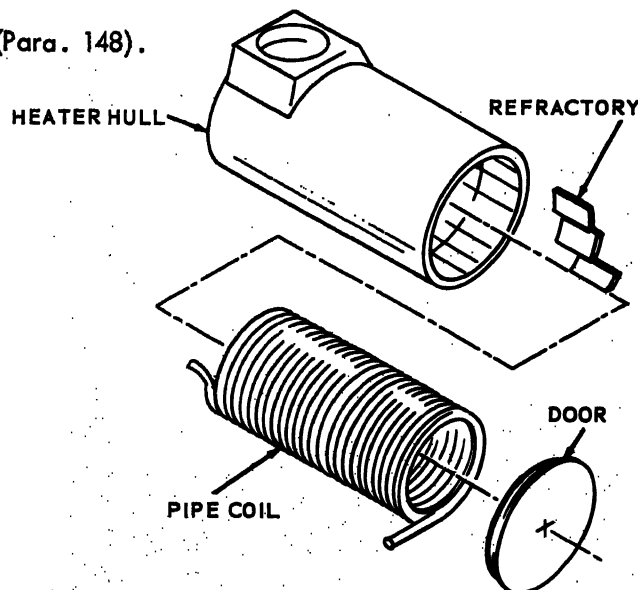


FIGURE 63. REMOVAL AND ASSEMBLY OF PIPING AND REFRACTORY

Section **XX.** NOSE BOX AND CABLE REEL MAINTENANCE

INSTRUCTIONS

193. General.

The nose box combines the air connection from the towing vehicle and the inter-vehicular wiring connection for the lights. The cable reel furnishes the means for holding the 100 foot power cable assembly and provides a ratchet for reeling the cable in for storage when not in use.

194. Removal.

- a. Remove the nose box and cable reel. (Para. 116 and 118).
- b. Remove the clearance light wiring (Para. 71).

195. Cleaning, Inspection, and Repair.

- a. Clean all parts with an approved cleaning solvent and dry thoroughly.
- b. Inspect the platforms for cracks, breaks, broken welds, rust and other damage.
- c. Inspect the mounting hardware for cracks, breaks, damaged threads and rust. Replace defective parts as may be necessary.

196. Installation.

- a. Install the clearance light wiring. (Para. 71).
- b. Install the Nose box and cable reel. (Para. 116 and 118).



FIGURE 64. MAINTENANCE INSTRUCTIONS TO BRAKES

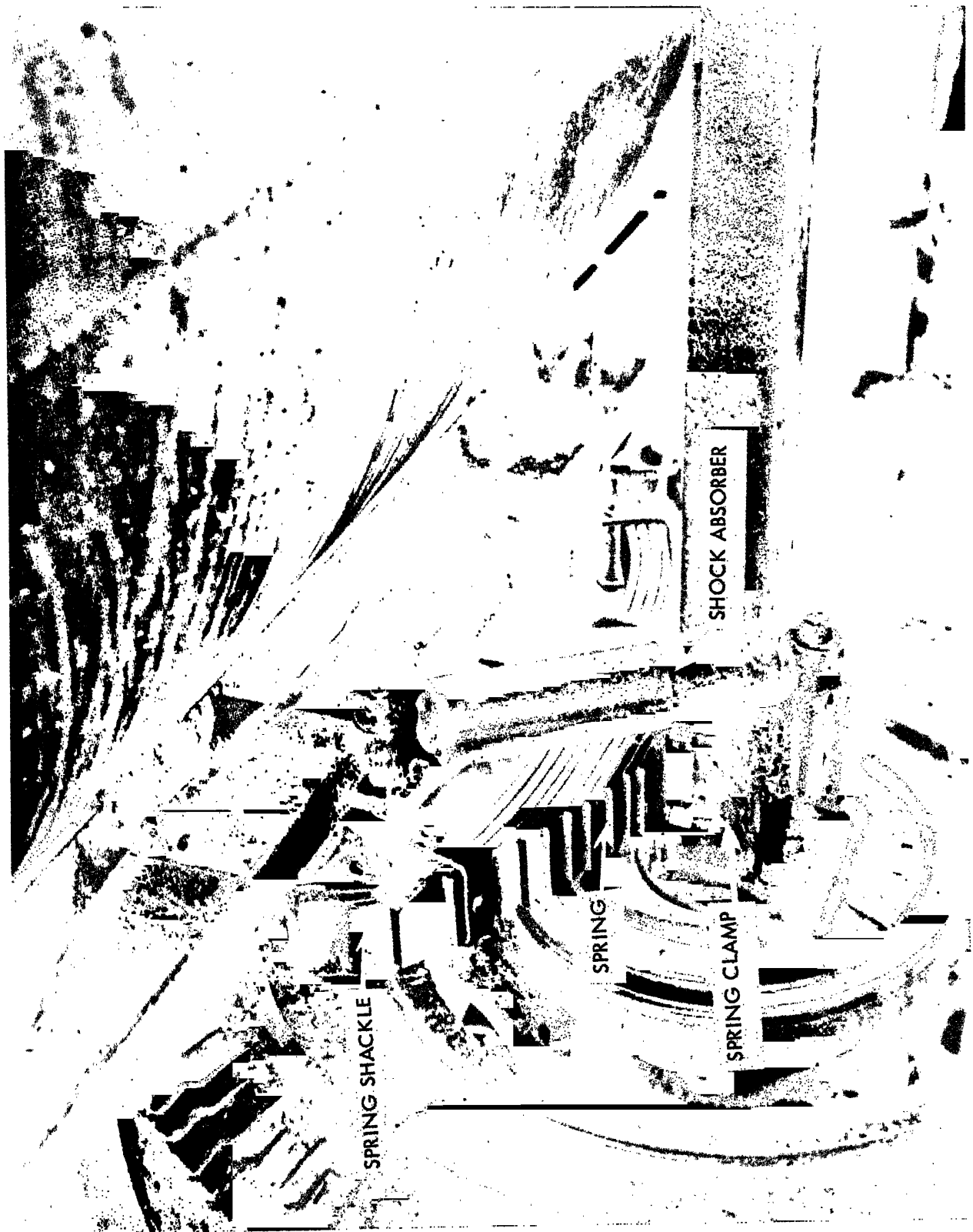


FIGURE 65. MAINTENANCE TRAILER SUPPORTS

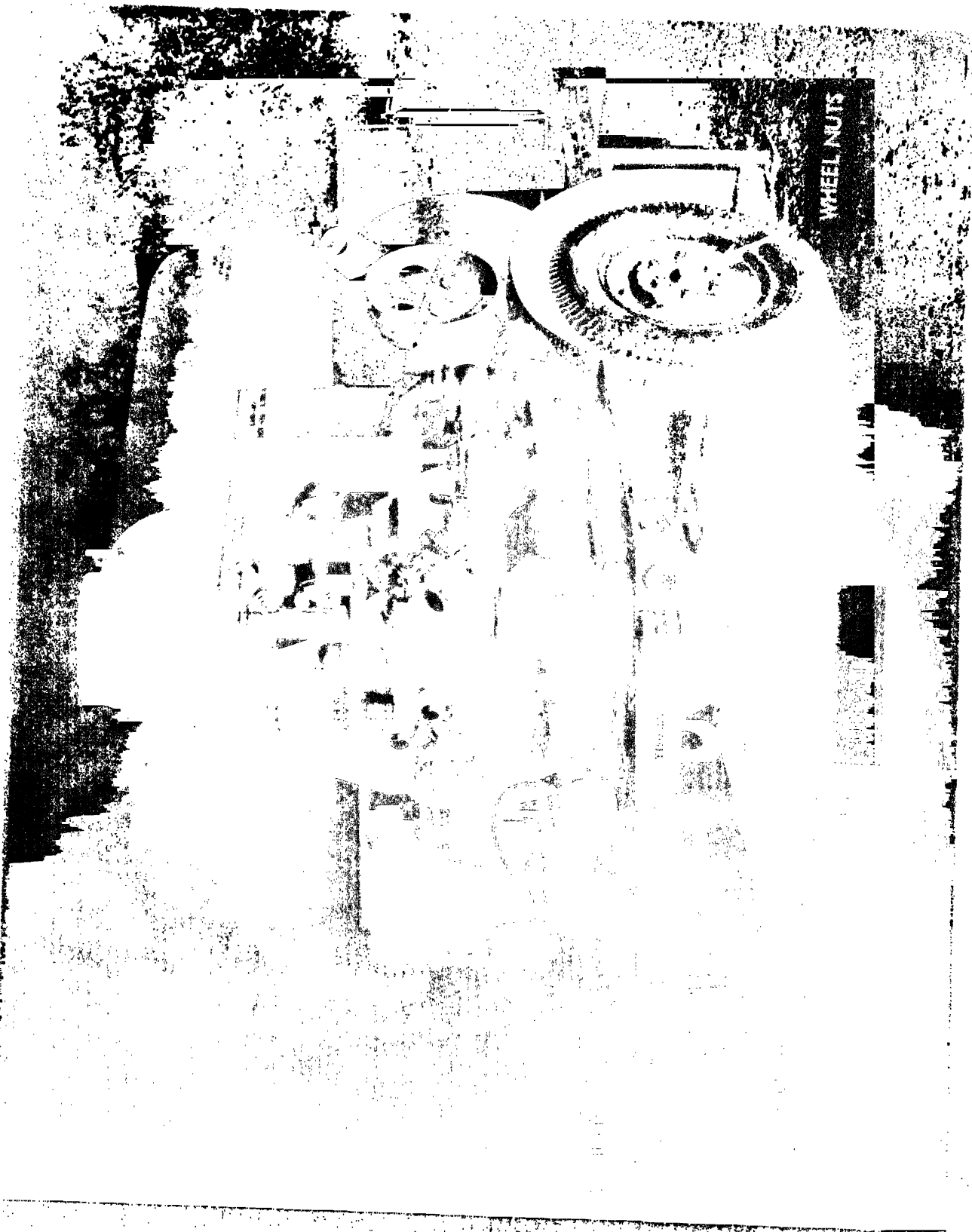


FIGURE 66: TIRE AND SUPPORT JACKS LOCATION

Section **XXI.** BRAKES, LINES AND FITTINGS, WHEELS AND RIMS,
MAINTENANCE INSTRUCTIONS.

197. General.

This Model 200 STM Hot Oil Heater is equipped with an air-over hydraulic brake system including a brake away emergency system.

198. Air Receiver Tank and Relay Valve.

a. Removal.

1. Remove the air receiver tank and relay valves. (Fig. 64).
2. Refer to Fig. 64 and disassemble the tank and relay valve.

b. Cleaning and Inspection.

1. Clean all parts with an approved cleaning solvent and dry thoroughly.
2. Inspect all parts for leaks, cracks, distortion, damaged threads, and rust.
3. Replace all defective parts as may be necessary.

c. Installation.

1. Refer to Fig. 64 and install the relay valve.
2. Refer to Fig. 64 and install the tank and relay valve into the system.

199. Tires, Wheels, Rims and Springs.

The unit is supported on two 900x20 ply tires which are in turn mounted on two 7.5x20 wheel assemblies mounted inboard of the wheels and directly under the main frame supports is one pair of 10,000 pound springs.

200. Removal.

- a. Remove the tire and rim assembly. (Fig. 67).
- b. Refer to Fig. 65 and remove the springs.
- c. Refer to Fig. 67 and remove the wheels.

201. Cleaning and Inspection.

- a. Clean all parts in an approved cleaning solvent and dry thoroughly.
- b. Inspect tires for breaks, signs of excess wear, tire pressure, bulges, rips, breaks and other damage. Inspect the wheels and springs for cracks, distortions, dents, displaced springs, damaged threads, and other damage.
- c. Repair or replace defective parts.

202. Reassembly and Installation.

- a. Refer to Fig. 67 and install the wheels.
- b. Refer to Fig. 65 and install the springs.
- c. Refer to Fig. 67 and install the tires.

203. Brakes and Bearings.

a. General.

The brakes are 13 x 2 1/2 wheel brakes activated by hydraulic wheel cylinders.
The bearings used are of the tapered variety.

NOTE: CARE SHOULD BE TAKEN WHEN REPLACING A WHEEL NOT TO TIGHTEN THE WHEEL NUT SO TIGHTLY AS TO CAUSE THE BEARINGS TO JAM. A SUGGESTED PRACTICE IS TO TIGHTEN THE NUT UNTIL THE WHEELS TURN SLIGHTLY ... THEN BACK OFF 1/2 TURN.

B. Removal.

1. Refer to Fig. 67 and remove the brake linings.
2. Refer to Fig. 67 and remove the bearings.

c. Cleaning, Inspection and Repair.

1. Clean all parts in an approved cleaning solvent and dry thoroughly.
2. Inspect for worn linings, wheel cylinder leakage and worn or defective bearings. Inspect all threads for damage and pins for wear. Replace all defective parts.

d. Reassembly and Installation.

1. Refer to Fig. 67 and replace the bearings, repack with approved specification of grease.
2. Refer to Fig. 67 and replace brake linings.

XX11 . MASTER CYLINDER MAINTENANCE INSTRUCTIONS

204 General.

The master cylinder is a diaphragm operated air valve which activates the hydraulic cylinder on the front portion of the assembly. This hydraulic motion in turn exerts pressure through the hydraulic lines causing the wheel cylinders to operate and they in turn transmit the applied force to the brake bands causing them to rub the brake drum. Due to the force applied in this manner the laws of friction come into play and the vehicle comes to a safe stop.

b. Removal. Refer to Fig. 68 and remove the master cylinder.

c. Cleaning and Inspection and Repair.

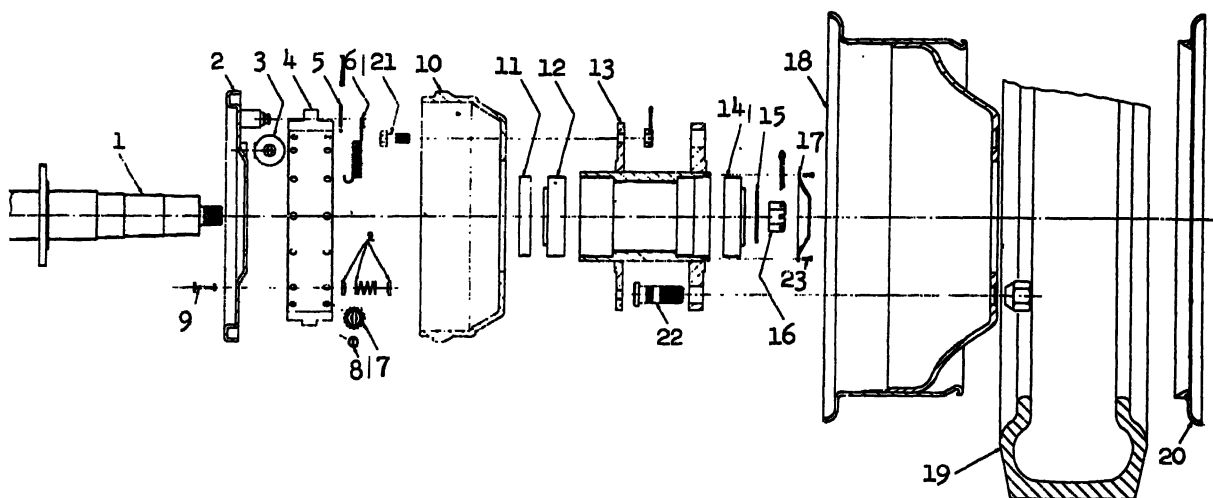
1. Clean all parts with an approved cleaning solvent and dry thoroughly.
2. Inspect for signs of leaks or cracks in the body of the master cylinder or damaged threads.

d. Disassembly and Reassembly.

- 1. Refer to Fig. 68 and disassemble the master cylinder.**
- 2. Replace all damaged and worn parts.**
- 3. Refer to Fig. 68 and reassemble the master cylinder.**

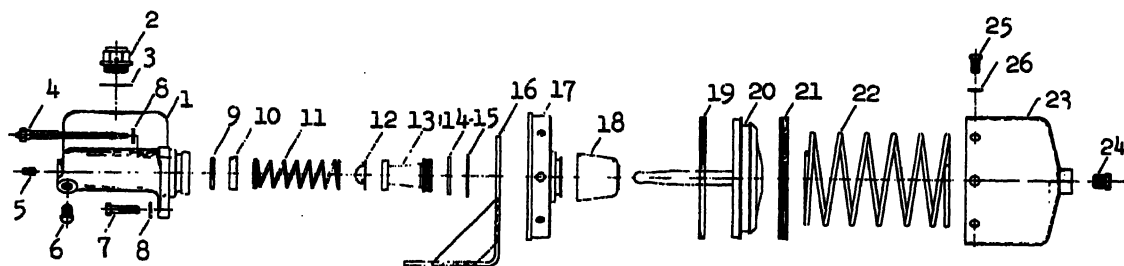
e. Installation.

- 1. Refer to Fig. 68 and install the master cylinder.**



- | | | |
|-------------------------|----------------------|---------------------------------|
| 1. Spindle | 9. Shoe retainers | 17. Dust cover |
| 2. Backing plate | 10. Brake drum | 18. Wheel rim |
| 3. Brake wheel cylinder | 11. Seal | 19. Tire |
| 4. Brake shoe | 12. Rear bearing | 20. Tire retainer ring |
| 5. Top shoe retainer | 13. Hub | 21. Drum bolts |
| 6. Return springs | 14. Front bearing | 22. Wheel rim bolts |
| 7. Adjuster | 15. Retaining washer | 23. Dust cover retaining screws |
| 8. Adjuster spring | 16. Hub nut | |

FIGURE 67. ASSEMBLY AND DISASSEMBLY OF WHEEL, BRAKES, BRAKE LININGS AND BEARINGS



- | | | |
|----------------------|------------------------|------------------------|
| 1. End housing | 10. End cap | 19. Felt wiper ring |
| 2. Vent plug | 11. Plunger spring | 20. Plunger |
| 3. Gasket | 12. Strainer | 21. Oil seal |
| 4. Adjustment bolt | 13. Plunger guide | 22. Plunger spring |
| 5. End plug | 14. Brass washer | 23. Seal housing cover |
| 6. Pipe plug (2) | 15. Snap ring | 24. Pipe fitting |
| 7. Mounting bolt (2) | 16. Mounting bracket * | 25. Cover bolt (8) |
| 8. Lock washer (3) | 17. Seal housing | 26. Lock washer (8) |
| 9. Washer | 18. Diaphragm | |

FIGURE 68 ASSEMBLY AND DISASSEMBLY OF MASTER CYLINDER

APPENDIX 1

REFERENCES

- 1. FIRE PROTECTION**
TM 5-687

**Repairs and Utilities: Fire Protection
Equipment and Appliances; Inspections,
Operations and Preventive Maintenance.**

- 2. PAINTING AND PRESERVATION**
TM 9-213

Painting Instructions for Field Use.

- 3. PREVENTIVE MAINTENANCE**
TB ENG 347
TM 38-750

**Winterization Techniques for Engineer
Equipment.
Army Equipment Record Procedures**

- 4. SUPPLY PUBLICATIONS**
C9100-1L

Fuels, Lubricants, Oils and Waxes

APPENDIX II

BASIC ISSUE ITEMS LIST

Section 1. INTRODUCTION

1. Scope

This appendix lists items which accompany the hot oil heater or are required for installation, operation or operator's maintenance.

2. General

This Basic Issue Items List is divided into the following sections:

a. Basic Issue Items -- Section II. A list of items which accompany the hot oil heater and are required by the operator/crew for installation, operation or maintenance.

b. Maintenance and Operating Supplies -- Section III. A listing of maintenance and operating supplies required for initial operation.

3. Explanation of Columns

The following provides an explanation of columns in the tabular list of Basic Issue Items, Section II.

a. Source, Maintenance and Recoverability Codes (SMR), Column I:
NOTE: Common hardware items known to be readily available in Army supply will be assigned Maintenance Codes only. Source Codes, Recoverability Codes, and Quantity Authorized will not be assigned to this Category of items.

(1) Source code, indicates the selection status and source for the listed item. Source Codes are:

Code	Explanation
P	Applied to repair parts which are stocked in or supplied from GSA/DSA or Army supply system, and authorized for use at indicated maintenance categories.

(2) Maintenance Code, indicates the lowest category of maintenance authorized to install the listed item. The maintenance level code is:

Code	Explanation
C	Operator/Crew.

(3) Recoverability code, indicates whether unserviceable items should be returned for recovery or salvage. Items not coded are expendable. Recoverability codes are:

Code	Explanation
R	Applied to repair parts and assemblies which are economically repairable at DSU and GSU activities and are normally furnished by supply on an exchange basis.
S	Applied to repair parts and assemblies which are economically repairable at DSU and GSU activities and which normally are furnished by supply on an exchange basis. When items are determined by a GSU to be uneconomically repairable, they will be evacuated to a depot for evaluation and analysis before final disposition.
T	Applies to high dollar value recoverable repair parts which are subject to special handling and are issued on an exchange basis. Such repair parts are normally repaired or overhauled at depot maintenance activities.
U	Applies to repair parts specifically selected for salvage by reclamation units because of precious metal content, critical materials, or high dollar value reusable casings or castings.

b. Federal Stock Number, Column 2. This column indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

c. Description, Column 3. This column indicates the Federal item name and any additional description of the item required. The abbreviation "v/e", when used as a part of the nomenclature, indicates the Federal stock number includes all armament, equipment, accessories, and repair parts issued with the item. A part number or other reference number is followed by the applicable five-digit Federal supply code for manufacturers in parenthesis. The physical security classification of the item is indicated by the parenthetical entry Repair parts quantities included in kits, sets, and assemblies are shown in front of the part name.

d. Unit of Measure (u/m), Column 4. A 2 character alphabetic abbreviation indicating the amount or quantity of the item upon which the allowances are based, e.g., ft, ca, pr, etc.

e. Quantity Incorporated in Unit, Column 5. This column indicates the quantity of the item used in the functional group or the assembly group. A "V" appearing in this column in lieu of a quantity indicates that a definite quantity cannot be indicated (e.g., shims, spacers, etc.).

f. Quantity Furnished With Equipment, Column 6. This column indicates the quantity of an item furnished with the equipment. As required items are indicated with an asterisk.

4. Explanation of Columns in the Tabular List of Maintenance and Operating Supplies -- Section III.

a. Component Application. Column 1. This column identifies the component application of each maintenance or operating supply item.

b. Federal Stock Number. Column 2. This column indicates the Federal Stock Number assigned to the item and will be used for requisitioning purposes.

c. Description, Column 3. This column indicates the item name and brief description.

d. Quantity Required for Initial Operation, Column 4. This column indicates the quantity of each maintenance or operating supply item required for initial operation of the equipment.

e. Quantity Required for 8 Hours Operation, Column 5. This Column indicates the estimated quantities required for an average 8 hours of operation.

f. Notes, Column 6. This column indicates informative notes keyed to data appearing in a preceding column.

SECTION II. BASIC ISSUE ITEMS

(1) SMR CODE	(2) FEDERAL STOCK NUMBER	(3) DESCRIPTION REF NO. & MFR CODE USABLE ON CODE	(4) UNIT OF MEAS	(5) QTY INC IN UNIT	(6) QTY FURN WITH EQUIP
		GROUP 31 - BASIC ISSUE ITEMS, MANUFACTURER INSTALLED			
		3100 - BASIC ISSUE ITEMS, MANUFACTURER OR DEPOT IN- STALLED			
P C	7510-889-3494	BINDER, LOOSELEAF: 3 ring type fasteners, Blind Em- bossed Printed. U. S. Army Equipment Logbook: For Re- placement Envelope see FSN 7510-763-5996.	EA		1
P C	7520-559-9618	CASE: Maintenance and Opera- tional Manual: W/1 pocket 16 in. h, 1-1/8 in. deep, 9-3/4 in. lg. and 1 pocket 16 in. h, 1-3/8 in. deep, 9 in. lg: 0/A dim., 22 in. h, 12-3/4 in. lg. MIL-B-11- 743.	EA		1
		DEPARTMENT OF THE ARMY: Operator, Organizational, Direct and General Support and Depot Maintenance Manu- al TM 5-3895-281-15.	EA		1
		GROUP 32 - BASIC ISSUE ITEMS, TROOP INSTALLED			
		3200 - BASIC ISSUE ITEMS, TROOP INSTALLED OR AUTHORIZED			
P C	4210-555-8837	EXTINGUISHER, FIRE: Monobromotrifluoromethane: Charged hand type, penetrat- ing seal valve W/bracket, 2-3/4 lbs. MIL Spec. 52-031.	EA		*

SECTION III. MAINTENANCE AND OPERATING SUPPLIES

(1) COMPONENT APPLICATION	(2) FEDERAL STOCK NUMBER	(3) DESCRIPTION	(4) QUANTITY REQUIRED F/ INITIAL OPERATION	(5) QUANTITY REQUIRED F/8 HRS OPERATION	(6) NOTES
6001 Vent Filler Plug	9150-965-2304	Lubricating Oil (Transfer Oil) General Purpose 55 Gal Drum MIL-L-22851 Type 3	230 Gal	See Notes 2, 3 & 4	(1) Surge Tank, Reservoir and Expansion Tank. (2) Heat Transfer Oil is not consumed. (3) The heater normally contains 230 Gal of oil when shipped. (4) Some user systems may require additional oil be added. (5) External Fuel Supply. Maximum fuel consumption is 26 gal per hr. of continual operation.
5513 Valves Strainer	9510-261-8289	Stick Grease ORG-MIL-C6032 24 Stick per box	(2) Sticks	1 Stick	
6004 Fuel Strainer	9140-286-5294	Fuel oil, burner bulk #2 Fuel oil, Gal	See Note (5)	200 Gal	

APPENDIX 111

MAINTENANCE ALLOCATION

Section 1. INTRODUCTION

1. General.

This appendix contains the explanations of all the maintenance and repair functions authorized at the various maintenance levels. Section II MAC (MAINTENANCE ALLOCATION CHART) designates overall responsibility for the performance of maintenance operations. Section 111 (TOOLS AND TEST EQUIPMENT REQUIREMENTS) contains a list of the special tools and special test equipment required for each maintenance operation as referenced from the MAC Section 11 column K. This section cross references a particular maintenance operation on the MAC when special tools and equipment are required to perform a specific task. Section IV (REMARKS) contains supplemental instructions, explanatory notes and/or illustrations required for a particular maintenance operation. This section is cross referenced to the MAC Section 11, column L.

2. Maintenance Operations

Maintenance is any action taken to keep material in a serviceable condition or to restore it to serviceability when it is unserviceable. Maintenance of material includes the following:

- a. Service. Operations required periodically to keep the item in proper operating conditions, i.e., to clean, preserve, drain paint, and replenish fuel, lubricate, hydraulic, and deicing fluids or compressed air supplies.
- b. Adjust. Regulate periodically to prevent malfunction. Adjustments will be made commensurate with adjustment procedures and associated equipment specifications.
- c. Align. Adjust two or more components of an electrical or mechanical system so that their functions are properly synchronized or adjusted.
- d. Calibrate. Determine, check, or rectify the graduation of an instrument, weapon, or weapons system or components of a weapons system.
- e. Inspect. Verify serviceability and detect incipient electrical or mechanical failure by close visual examination.
- f. Test. Verify serviceability and detect incipient electrical or mechanical failure by measuring the mechanical or relectrical characteristics of the system and comparing those characteristics with authorized standards. Test will be made commensurate with test procedures and with calibrated tools and/or test equipment referenced on the MAC.
- g. Replace. Substitute serviceable components, assemblies, and subassemblies for unserviceable counter parts or remove and install the same item when required for the performance of other maintenance operations.
- h. Repair. Restore to a serviceable condition by replacing unserviceable parts or by any other action required using available tools, equipment and skills to include welding, grinding, riveting, straightening, adjusting and facing.
- i. Overhaul. Restore an end item to completely serviceable condition as prescribed by serviceability standards developed and published by heads of technical services. This is accomplished through employment of the technique of "Inspection and repair only as necessary". (IROAN). Maximum use of diagnostic and test equipment is combined with

minimum disassembly during overhaul. "Overhaul" may be assigned to any level of maintenance except organizational, provided the time, tools, equipment, repair parts authorization, and technical skills are available at that level. Normally, overhaul as applied to the end items is limited to depot maintenance level.

j. Rebuild. Restore to a condition comparable to new by disassembling to determine the condition of each component part and reassembly using serviceable, rebuilt, or new assemblies, subassemblies, and parts.

3. Explanation of Columns in Section 11

a. Functional Group Number. The functional group is a numerical group set up on a functional basis. The applicable functional grouping indexes (obtained from TB750-93-1 Functional Grouping Codes) are listed on the MAC in the appropriate numerical sequence. These indexes normally are set up in accordance with their function and proximity to each other.

b. Component Assembly Nomenclature. This column contains the functional grouping index heading. Subgroups heading, and a brief description of the part starting with the name.

c. Essentiality. The essentiality column reflects whether or not an assembly, or repair part, is combat essential to the tactical use of the end item. The letter "E" in this column indicates the items are combat essential.

d. Maintenance Operations and Maintenance Levels. This column contains the various maintenance operations A through J, service, adjust, etc. A symbol indicating the maintenance level placed in the appropriate column in line with an indicated maintenance operation authorizes that level to perform the function. The symbol indicates the lowest level of maintenance responsible for performing the function, but does not necessarily indicate repair parts stockage at that level. Higher levels of maintenance are authorized to perform the indicated functions of lower levels. The symbol designation for the various levels are as follows:

O/C -- Operator or crew
O -- Organizational
DS -- Direct Support
GS -- General Support
D -- Depot

e. Reference note. This column is subdivided into two columns. Column K references the tool and test equipment requirements (T and TE) Section 111 of the MAC. Column L references the remarks Section IV of the MAC.

4. Explanation of Columns in Section 111

a. Reference Code. This column consists of a number and a letter separated by a dash. The number references the T and TE requirements column on the MAC.

The letter represents the specific maintenance operation the item is to be used with. The letter is representative of column A through J on the MAC.

b. Maintenance Level. This column shows the lowest level of maintenance authorized to use the special tool or test equipment.

c. Nomenclature. This column lists the name or identification of the tool or test equipment.

d. Tool Number. This column lists the manufacturer's code and part number, or Federal stock number, of tools and test equipment.

5. Explanation of Columns in Section IV.

a. Reference Code. This column consists of two letters separated by a dash. The first letter references column L., the second letter references a maintenance operation, Column A through J on the MAC Section 11.

b. Remarks. This column lists the remarks and other information pertinent to the operation being performed as indicated on the MAC Section 11.

SECTION II

MAINTENANCE ALLOCATION CHART

FUNCTIONAL GROUP NUMBER	FOR: Heater, Hot Oil, Electric Driven, Trailer, Mtd., Pneu. Tired, Hopkins Model	ESSENTIALITY	MAINTENANCE LEVELS										NOTE REF	
			MAINTENANCE OPERATIONS											
			A	B	C	D	E	F	G	H	I	J		K
			SERVICE	ADJUST	ALIGN	CALIBRATE	INSPECT	TEST	REPLACE	REPAIR	OVERHAUL	REBUILD	TELE RQMT	REMARKS
06			ELECTRICAL SYSTEM											
0609			Lights:						0					
			Signal and clearance						O/C					
			Bulbs											
0613			Hull or Chassis Wiring Harness:											
			Wire assembly						DS	0				
0617			Trailer Couplings											
			Cable assembly						DS	0				
11			REAR AXLE											
1100			Rear Axle Assembly						0	DS				
			Axle, rear						0					

[illegible]

MAINTENANCE ASSIGNMENT CHART

FUNCTIONAL GROUP NUMBER	FOR: Heater, Hot Oil, Electric Driven, Trailer, Mtd., Pneu. Tired, Hopkins Model	COMPONENT ASSEMBLY NOMENCLATURE	ESSENTIALITY	MAINTENANCE LEVELS												NOTE REF																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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MAINTENANCE ALLOCATION CHART

FUNCTIONAL GROUP NUMBER	FOR: Heater, Hot Oil, Electric Driven, Trailer, Mtd., Pneu. Tired, Hopkins Model	ESSENTIALITY	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE LEVELS										NOTE REF
				MAINTENANCE OPERATIONS										
				A	B	C	D	E	F	G	H	I	J	K
			SERVICE	ADJUST	ALIGN	CALIBRATE	INSPECT	TEST	REPLACE	REPAIR	OVERHAUL	REBUILD	TELE RQM	REMARKS
07			ELECTRIC MOTORS											
4000			Major Assemblage; Motor Generator:											
			Motor, pump						0	0	DS	CS		
4001			Rotor Assemblies:											
			Rotor						DS	DS	D	--	--	A
4002			Stator Assemblies:											
			Stator						DS	DS	D	--	--	B
4004			Ventilating System:											
			Fan						DS	DS				
4005			Frame Support and Housing:											
			Frame						DS					

MAINTENANCE ALLOCATION CHART

FUNCTIONAL GROUP NUMBER	FOR: Heater, Hot Oil, Electric Driven, Trailer, Mtd., Pneu. Tired, Hipkins Model	ESSENTIALITY	MAINTENANCE LEVELS												NOTE REF
			MAINTENANCE OPERATIONS												
			A	B	C	D	E	F	G	H	I	J	K	L	
COMPONENT ASSEMBLY NOMENCLATURE			SERVICE	ADJUST	ALIGN	CALIBRATE	INSPECT	TEST	REPLACE	REPAIR	OVERHAUL	REBUILD	TEST POINT	REMARKS	
4010	Master or Auxiliary Control Assembly:									DS					
	Starters, Motor								O						
	Heater								O						
4016	Junction Boxes:														
	Junction boxes								O						
	Bus bars								O						
42	ELECTRICAL EQUIPMENT														
4201	Transformer								G						
4202	Electrical Controls:														
	Control box								DS	O					
	Wiring								O						

MAINTENANCE ALLOCATION CHART

FUNCTIONAL GROUP NUMBER	FOR: Heater, Hot Oil, Electric Driven, Trailer, Mtd., Pneu. Tired, Hopkins Model.	COMPONENT ASSEMBLY NOMENCLATURE	ESSENTIALITY	MAINTENANCE LEVELS												NOTE REF
				MAINTENANCE OPERATIONS												
				A	B	C	D	E	F	G	H	I	J	K	L	
				SERVICE	ADJUST	ALIGN	CALIBRATE	INSPECT	TEST	REPLACE	REPAIR	OVERHAUL	REBUILD	TEST POINT	REMARKS	
4203		Cutoff Devices, Fuse, Fuse Holders Cutoff, low fluid level Fuse block; fuse Control, pressure, photocell; cable; jack; valve, oil switch Program controller Vacuum tubes Thermostat, Automatic and Manual Control Devices: End switch Controller, temperature								0	0	DS				
4206										0	0	DS				

MAINTENANCE ALLOCATION CHART

FUNCTIONAL GROUP NUMBER	FOR: Heater, Hot Oil, Electric Driven, Traller, Mtd., Pneu. Tired, Hopkins Model	COMPONENT ASSEMBLY NOMENCLATURE	ESSENTIALITY	MAINTENANCE LEVELS											NOTE REF	
				MAINTENANCE OPERATIONS											K	L
				A	B	C	D	E	F	G	H	I	J			
				SERVICE	ADJUST	ADJUNE	CALIBRATE	INSPECT	TEST	REPLACE	REPAIR	OVERHAUL	REBUILD		TYPE RQMT	REMARKS
4209		Signaling Devices:														
		Lamp														
4216		Miscellaneous Wiring and Fittings:														
		Junction box; conduits; wires;														
		connectors; clamps														
47		GAGES														
4702		Gages:														
		Gage, temperature and pressure														
		Gage, liquid level														
		Lines and fittings														
55		PUMP														

MAINTENANCE ALLOCATION CHART

FUNCTIONAL GROUP NUMBER	FOR: Heater, Hot Oil, Electric Driven, Trailer, Mtd., Pneu. Tired, Hopkins Model	COMPONENT ASSEMBLY NOMENCLATURE	ESSENTIALITY	MAINTENANCE LEVELS										NOTE REF	
				A	B	C	D	E	F	G	H	I	J	K	L
				SERVICE	ADJUST	ALIGN	CALIBRATE	INSPECT	TEST	REPLACE	REPAIR	OVERHAUL	REBUILD	TELE RMT	REMARKS
5500		Pump Assembly: Pump circulating Pump base plate			O/C					O	DS				
5501		Shaft, Impeller: Shaft; impeller								O					
5502		Rings, Bearings: Bearings; rings							DS	DS					
5508		Lubricators: Pump drain line; cup								O/C					
5511		Couplings: Coupling, drive Guard								O	O				

MAINTENANCE ALLOCATION CHART

[illegible]

MAINTENANCE ALLOCATION CHART

FUNCTIONAL GROUP NUMBER	FOR: Heater, Hot Oil, Electric Driven, Trailer, Mtd., Pneu. Tired, Hopkins Model	COMPONENT ASSEMBLY NOMENCLATURE	ESSENTIALITY	MAINTENANCE LEVELS										NOTE REF	
				A	B	C	D	E	F	G	H	I	J	K	L
				SERVICE	ADJUST	ALIVE	CALIBRATE	INSPECT	TEST	REPLACE	REPAIR	OVERHAUL	REBUILD	W/TE RQMT	REMARKS
6004		Fuel System Cont'd. Pump, fuel Strainer, fuel Lines and fittings Burner Assembly: Plate, transformer; air cone Burner head Blower Transformer, igniter Nozzle and electrode Motor, control; butterfly; coupling		0	O/C					0	DS				
6005										0	0				
										DS					
										0	0				
										0					
										0	0				
										0					
										0					
										0					

MAINTENANCE ALLOCATION CHART

FOR: Heater, Hot Oil, Electric Driven, Trailer, Mtd., Pneu. Tired, Hopkins Model		ESSENTIALITY	MAINTENANCE OPERATIONS								MAINTENANCE LEVELS				NOTE REF
			A	B	C	D	E	F	G	H	I	J	K	L	
			SERVICE	ADJUST	ALIGN	CALIBRATE	INSPECT	TEST	REPLACE	REPAIR	OVERHAUL	REBUILD	WRITE POINT	REMARKS	
COMPONENT ASSEMBLY NOMENCLATURE															
6006	Motor Assembly: Motor, blower Exhaust System: Stack, exhaust Combustion chamber: Refractory Heat Exchanger Assembly: Coil, heater								0	0	DS				
6010															
6011															
6013											DS				
76	FIRE FIGHTING EQUIPMENT														
7603	Fire extinguisher: Extinguisher, fire										CS				
															</

**Section III. SPECIAL TOOL AND SPECIAL TEST
EQUIPMENT REQUIREMENTS**

REFERENCE CODE	MAINTENANCE LEVEL	NOMENCLATURE	TOOL NUMBER
		<p>HEATER, HOT OIL, 2,100,000 BTU/HR OUTPUT TRAILER MOUNTED (HOPKINS MODEL 200STM) FSN 3895-679-3898 CONTRACT NO. DAAK01-67-C-0787</p> <p>No special tools required.</p>	

Section IV. REMARKS

REFERENCE CODE	REMARKS
	<p>HEATER, HOT OIL, 2,100,000 BTU/HR OUTPUT TRAILER MOUNTED (HOPKINS MODEL 200STM) FSN 3895-679-3898 CONTRACT NO. DAAK01-67-C-0787</p>

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